THURSDAY, JANUARY 18, 1900.

THE PRINCIPLES OF MECHANICS.

Newton's Laws of Motion. By Prof. P. G. Tait. Pp. viii+52. (London: A. and C. Black, 1899.)

HOW is the science of mechanics to be taught to medical students who have to "get up" natural philosophy in three months? If a teacher, confronted with such a problem, took refuge in sheer "cram," his action could cause no astonishment; an attempt, such as Prof. Tait has made, to provide a solution in which cram has no place commands admiration, even if it cannot be pronounced successful. The author's method is to furnish the student with a set of perfectly recorded lecture notes, and thus leave him free to follow the lectures instead of taking notes of them. Perhaps no better method can be devised, if the substance of the lectures is as good as the record in the notes is perfect, and if the student is made to apply the ideas explained in the lectures to simple examples. The latter of these conditions is doubtless fulfilled in Prof. Tait's classes; we are concerned here with what can be made out in regard to the former. After all the books that have been written on the subject, there was still room for a pointed statement of the principles of mechanics, with sufficient detail and sufficient illustration, but short; and such a summary, if only it were precise and lucid, could not fail to be useful to a class much wider than that immediately in view; but its value would be diminished in proportion as it was marked by vague statement, inexact definition and loose argument.

The work before us begins with three pages of introductory remarks, and these are followed by a chapter on kinematics and a chapter on dynamics. In the introductory pages we find a statement of the laws of the conservation of matter and of energy, and a reference to the laws of the inertia of matter and of the transformation of energy. As a specimen of the dogmatic tone adopted we may quote the following:—

"The objective realities of the physical world are of two kinds only—matter and energy. Our conviction of their objectivity is based on the experimental fact that we cannot alter the quantity of either."

No exception could be taken to this statement if the evidence for it were going to be adduced; and indeed the kind of summary that is likely to be most useful is just one that would trace the operation of the laws of conservation and transformation of energy, and of the law of the inertia of matter, in the processes of everyday experience and in easily observed phenomena. In picking out *mass* and *energy* as the two fundamental conceptions the author is certainly right, but much depends on the way in which they are discussed.

The same wisdom in the selection of the topics to be treated is apparent in the chapter on kinematics, and the arrangement also of these topics is excellent; it is to some of the details that exception must be taken. There is a general discussion of *vectors*, but the definition which is given of a vector is incomplete, and the necessary distinction between a vector associated with a particular line and one for which all parallel lines are equivalent is not explained. In the definition which is given of the *moment of a vector*, the fact that the rule of signs is a part of the definition is lost sight of, and the reason why the moment itself should be regarded as a vector is obscure. The proof, on p. 20, that angular velocity is a vector involves a *petitio principii*. In this, as in the proof of the parallelogram of velocities, what is most required is an explanation of the sense in which a point can be said to have two simultaneous velocities, or a body two simultaneous angular velocities. The definition of *velocity* is always one of the stumbling-blocks in the way of students; the author avoids giving a definition; he says, "Speed need scarcely be defined, as every one knows what it means." It may be that the writers of current text-books know what it means; they seem quite unable to explain it; nearly all of them proceed in a vicious circle, saying that the velocity of a point when variable is measured at any instant by the space that would be passed over in a unit of time if the velocity continued the same as it is at the instant—as well might one define the curvature of a curve at a point as the angle that would be contained between the tangents at the ends of an arc of unit length if the curvature continued the same all along the arc as it is at the point. If the student is not meek he will ask, "But what is it at the point?" It is only because he thinks he "knows what it means" that he does not ask the like question about speed. Prof. Tait gives countenance to the widely-spread vicious definition without reproducing it. Surely he might have spared some space to explain the mathematical notion of a limit, and to define velocity as a limit. Why do writers of elementary books treat the student as a baby when any limit is in view, and talk to him, for example, about "the next point" to a point on a curve? (p. 9). He knows as well as his teacher that there is no next point. The commonly received absurdities about what are really limiting processes secure acquiescence by frequent repetition, but they foster in the mind of the student a belief in the unreality of the whole business.

The chapter on dynamics suffers from defects which are not merely faults of detail, but arise from the position taken up, viz., that Newton's laws of motion still form the simplest foundation of the subject. Some remarks in Prof. Tait's address to Section A of the British Association in 1871, dealing with the use of Euclid's "Elements" by British mathematicians in the teaching of elementary geometry, apply, with at least equal force, to the use of Newton's laws of motion in the teaching of elementary dynamics. He said of the teachers:

"They seem voluntarily to weight alike themselves and their pupils for the race; and a cynic might, perhaps without much injustice, say they do so that they may have mere self-imposed and avoidable difficulties to face instead of the new, real, and dreaded ones."

The defect of the laws of motion as a statement of the principles of dynamics is not that the principles are not implicitly contained in the laws, but that the principles have to be extracted from the laws, and that the laws themselves are stated in terms of insufficiently defined abstractions. How much of the contents of the

laws of motion is of the nature of definition, and how much is a statement of facts ascertained experimentally, is not disclosed. To assert that these laws still form the simplest foundation for the subject is to ignore the progress that has been made since the publication of Thomson and Tait's "Natural Philosophy." The difficulties into which writers who follow Newton uncritically must needs fall can be illustrated by sentences on pp. 27 and 28. On p. 27 we read, "Force is defined as any cause which alters the momentum of a body"; and on p. 28 we are told that force is "merely another name" for "the vector-acceleration of momentum." This makes the same word do duty for the cause of the change and the rate of the change. Others of the definitions given are wanting in precision. The definition of the *mass* of a body as the quantity of matter in it is a definition of one previously undefined thing in terms of another. The description of the first law of motion as a "statement of the inertia of matter" is not helpful; inertia is a property of matter under ordinary conditions, and the first law is a statement about matter under conditions in which it has never been observed. It ought to be realised that the three laws form a connected system, and that all of them are as much needed as any one of them for the precise definition of *force*, or the exact statement of the inertia of matter. The definition given of *work done* is obscure; the work of a force is defined as a product, and no indication is given of the sense in which this product can be said to be "done." What is wanted here is much the same as in the case of force: we all have an anthropomorphic idea that some cause must operate to start or stop the motion of a body; we have a similar idea that a man has done something when he has lifted a weight or thrown a cricket ball, and these ideas should be taken hold of and made precise by the introduction of measurable quantities which are adequate to represent them.

The difficult ground of definition and statement of principles once covered, the rest of the book is for the most part excellent, the geometrical methods employed being especially elegant. Room is found for an elementary discussion of strain, of compounded simple harmonic motions, of attractions, including the distribution of electricity on a sphere under influence, and of the velocity of waves along a stretched cord, in addition to interesting and unhackneyed accounts of the matters which are the stock-in-trade of books on the elements of mechanics. The book on the whole is thoughtful, in many parts it is much better than the current text-books, and the parts that call for criticism are no worse than the corresponding parts of most other books on the subject; but they are the most important parts, and they might have been so much better. There was a great opportunity, and it has been missed. A. E. H. L.

THE SCIENCE OF LAND FORM.

Physical Geography. By Prof. W. M. Davis, assisted by W. H. Snyder. Pp. xvii + 428 + 9 plates. (Boston and London: Ginn and Co., 1899.)

AN examination of this volume gives rise to feelings of both congratulation and regret—congratulation that so admirable a manual for the elementary student of physical geography has been produced, and regret that so little attention is given to the subject in our schools and colleges. Rational methods of instruction are now advocated for all the concrete sciences, and are being extensively applied to physics and chemistry; but geography has only been very slightly benefited by the pedagogic reforms of the last decade, and in the majority of our secondary schools it is still represented by definitions, outline maps, uninteresting statistics, and lists of names which make no real impression upon the minds of the pupils. Physical geography, the elements of which should be presented at the very beginning of the study of the earth, is usually neglected altogether, or taught in a fashion that fails entirely to place pupils in the receptive intellectual attitude reached after sound instruction in any science.

The present position results chiefly from the want of teachers with a broad conception of the field of geographical science. Every teacher is supposed to be qualified to give instruction in geography; and if the word merely signified the description of the political divisions of the earth, any one could put pupils in the way of acquiring that information. But, rightly defined, geography should be the consideration of the earth as the abode of man, and it should comprise the elements of astronomy, physics, meteorology, botany, zoology, and ethnology, as well as knowledge of commerce and government. To present the subject in these broad aspects, the teacher must be inspired by the scientific spirit and have given personal attention to the facts and phenomena of nature; and where such teachers are not available instruction in geography cannot proceed on scientific lines.

The volume under notice provides an admirable means of improving geographical teaching. Prof. Davis is not only an expert in most of the branches of physical geography; he is also a practical teacher who has devoted much attention to the educational side of the subject. The result is that, with the assistance of Mr. Snyder, he has produced what is certainly one of the best manuals of physical geography ever published. The book is well planned, trustworthy, clearly written, and liberally illustrated; it presents the facts of physical geography in such a way that the reader sees them as part of an organic whole—as organised knowledge which constitutes science. The facts are traced backward to their causes and forward to their consequences; indeed the phrase "causes and consequences" has served as a touchstone by which the treatment of each subject has been tested.

The order of treatment is the earth as a globe, the atmosphere, the oceans, and the lands. These facts are not, however, treated in equal detail; indeed, the last part occupies more than four times the number of pages devoted to the three preceding parts taken together. From this it will be seen that the book is not concerned with physiography as it is usually understood in this country, but with the science of land form In physiography the student receives practical instruction in physics, chemistry, astronomy and cognate sciences before he considers atmospheric phenomena the circulation of water on the land, the earth's solid

crust, and the changes which take place in it: in physical geography, however, the facts of physical science are made subservient to the descriptions of land forms and other matters directly connected with the study of the earth. In the present volume, for instance, "the non-geographical elements of astronomy, the principles of physics, and the divisions of geological time, are carefully excluded." The authors are, of course, entirely justified in limiting the sections dealing with these subjects to any dimensions they please; and many teachers of physical geography will agree that the method of treatment adopted distinctly defines the scope of physical geography. At the same time, the opinion of the writer is that it is impossible for a student to clearly perceive many of the facts of physical geography unless he has a practical acquaintance with physical science. A student with a knowledge of Boyle's law can fully understand why half the earth's atmosphere is left behind in ascending to a height of three and a half miles above sea-level; but a student of physical geography may be told that this is the case, and have no real conception of the cause. Almost every fact concerning the constitution and movements of the atmosphere can be far more easily comprehended by students who have received experimental instruction in the principles of physics than by those who read them for the first time in connection with natural phenomena. Similar introductory knowledge is also required to intelligently follow the action of internal forces such as give rise to volcanic eruptions, the system of oceanic movements, the solvent and disintegrating actions of water, causes which affect climate, and many other natural operations and conditions. A practical knowledge of the principles of the science of matter and energy is indeed essential to the scientific study of the earth; and without such knowledge students of physical geography can have only a limited comprehension of the causes of natural processes.

As bearing upon this point, mention may appropriately be made of a new syllabus of physical geography which has just been prepared for the Cambridge Local Examinations. The syllabus includes a course of practical instruction drawn up with the distinct object of cultivating the pupils' faculties of observation and reasoning; it therefore represents a praiseworthy attempt to make lessons in physical geography of real educational value. So far as the descriptive part is concerned, the volume under notice is exactly the kind of book to use in classes which follow the Cambridge course, and the appendices will be found of service in showing the observations which may be usefully made out of doors. But the sections on the atmosphere and on astronomical geography are too brief to be clearly comprehended by students unfamiliar with the rudiments of physics and astronomy. In the Cambridge syllabus experimental work in each of these divisions of physical geography is rightly given prominence; and we consider that a larger amount of space might have been devoted to them with advantage in the present volume. As these sections now stand they will convey information, but will not do much to encourage individual observation. Moreover, most teachers will find it necessary to postpone the descriptions of atmospheric circulation to a later stage than is suggested by the place in which it is here dealt with; for though the volume contains a most admirable account of wind systems, every teacher knows that charts of winds and isotherms are not easily visualised by the student who has not learned to read such diagrams.

Apart from the question of the relative importance which should be attached to the different divisions of physical geography, it would be difficult to suggest how the volume could be improved. No better description of the lithosphere, and the changes which take place in it, could be desired by the student of physical geography than is given by the authors. The examples of characteristic land forms are naturally more often American than European or British; but as emphasis is always laid upon the association of land forms with settlements and industries, a useful lesson is conveyed even if the selected district is strange to the reader. Several words, such as *monadnock*, *cuesta*, *drumlin*, *peneplain*, *esker*, and *mesa*, not usually found in books of physical geography used in this country, are employed to describe particular formations, though no explanation appears to be given of more common terms in physical geography, such as *hydrosphere*, *lithosphere*, *erratic*, *volcanic dyke*, *geoid*, *Roches moutonnées*, *scoriae*, *tundra*, *selvas*, *pampas*, and *regelation*—or if they are mentioned they are not indexed. Little importance need be attached to this, for physical geography should be more than a collection of definitions; but as the student will in all probability meet with the words later, he should know their significance. This is, however, but a minor point, for a good dictionary will furnish the meanings of these words, but it is only occasionally that a volume of such an inspiring character as the one here noticed is produced, and where so many good qualities are exhibited, a judicious critic hesitates to suggest any alterations. R. A. G.

THE REMINISCENCES OF A. D. BARTLETT.

Bartlett's Life among Wild Beasts in the "Zoo." By the late A. D. Bartlett. Edited by E. Bartlett. Pp. xviii + 375. (London: Chapman and Hall, Ltd., 1900.)

THE issue of the present volume may be taken as an indication that its predecessor, "Wild Animals in Captivity," was a success and has met with the appreciation of the public. Obviously, therefore, it is not the part of a critic to decry what has practically been already approved, the work before us being a continuation of the first series of Reminiscences. Undoubtedly there is a very large amount of extremely entertaining matter in this second venture. Especially is this the case with regard to the author's experiences of Gorillas and Chimpanzees, his important practical experiments and observations with regard to hybrids, his account of the verification of the hunters' stories as to the annual shedding of its horns by the American Prongbuck, and his description of the habits of the Indian Panda, or Cat-bear. The latter observations afford, indeed, an excellent example of the acuteness of Bartlett's judgment as to the affinity of an animal by the study of its habits alone. The systematic position of the Panda was at the time in question much disputed. Mr. Bartlett insisted on its

near relationship to the Racoons, especially the Kinkajou: and his opinions were more than borne out by the contemporary investigations of Sir W. H. Flower into its internal anatomy. The public, too, will be much interested to learn that Bartlett was a firm believer in the existence of a "sea-serpent," although whether they will be inclined to share his opinion that there are reptiles that can live for months at a time at the bottom of the ocean without coming up to breathe may be questioned.

But much as these and many other portions of the book may interest and attract the general reader (not to mention the scientific naturalist), there are other parts for which such commendation can scarcely be claimed. We have, for instance, several descriptions of species, such as that of the white-whiskered Lemur (*L. leucomystax*) on p. 22, and Monteiro's Galago (*G. monteiri*) on p. 24, which can be of no possible interest to any one but a specialist, especially in the absence of figures. But this is not all, as the aforesaid Lemur is now regarded by qualified naturalists merely as the female of (*L. macaco*), and its retention as a species is consequently a mere misleading of the public.

If this were the sole instance of a want of efficient editorship it might, indeed, well have been passed over in silence, but unfortunately it is only one among many. For instance, on the very first page of the volume we have a repetition of the old story that the Apes seen by Hanno, the Carthaginian, were Gorillas (in the modern sense of that term), whereas it has been shown over and over again that such could not have been the case; Mr. Winwood Reade believing the creatures to have been Baboons, while Sir Harry Johnstone thinks they were more probably Chimpanzees. Neither is it a true statement that the skull of the Gorilla obtained by Dr. Savage at the Gaboon was ever sent to Owen, who only received sketches of the same; the specimen itself having apparently gone to America. It is quite true that these statements were made by the author of the papers which constitute this volume, but it was for the editor to have made the necessary amendments.

Then, again, we have to deplore a lack of efficient editorship in the manner in which the different sections of the book are introduced, or rather not introduced. For example, who would guess that the dissertation on hybrid bovine animals, commencing on p. 71, is reproduced, with the exception of the opening sentence, word for word from the *Proceedings* of the Zoological Society for 1884? And if the quotation is not acknowledged as such by the usual marks in this place, why are such marks introduced in another equally long quotation from the same serial on p. 6? Neither is there any indication to show that the portrait of the Chimpanzee "Sally" on p. 7, as well as the picture of hybrid Cattle on p. 70, are copied from plates in the Zoological Society's *Proceedings*. And very indifferent copies at that, the reader will probably add! Indeed, the illustrations generally are far from being a strong point of the book, while, like the regiments in the British army, there are too few of them.

Neither can we avoid saying that the nomenclature is hopelessly out of date; this being sufficiently apparent when we mention that *Troglodytes* is given as the generic name of the Chimpanzee and Gorilla, *Ceriornis* for the Tragopan, and *Felis* for the Hunting Leopard or Chita! If popular writers will not keep somewhat in touch with the systematic work of the day, it is their fault if they are treated with contempt by professional naturalists.

In spite of the errors and imperfections to which we have called attention, we, as already said, fully recognise the large amount of interesting matter in the volume before us; and if our readers desire a really amusing story, we may refer them to the adventure of Mr. and Mrs. Jamrach with the Lions. At the same time, we think that the editor would have been much better advised had he reduced the present volume and its companion to the limits now occupied by one of them.

R. L.

ELECTRICAL OSCILLATIONS.

Recherches Expérimentales sur les Oscillations Électriques. Par A. Turpain. Pp. 154. (Paris: Librairie Scientifique, A. Hermann, 1899.)

THE classical researches of Hertz on electromagnetic waves have opened up a new field of experimental research, which has already yielded a rich harvest of results. As regards the literature of the subject, we have, besides Hertz's original papers, two or three other works dealing with the theory and phenomena of electromagnetic waves. Dr. Lodge's little book contains a general and easily intelligible sketch of the whole subject. In Prof. J. J. Thomson's "Recent Researches" we have an elaborate exposition of theory, along with an account of the experimental development of the subject down to the date of publication. Poincaré's "Oscillations Électriques" is probably the best-known Continental work on electromagnetic waves.

The work before us is one which does not trench on the ground already covered by the above-named treatises. It is a record of original researches, some of which have already appeared in various scientific periodicals. The scope of these researches is limited to the propagation of waves along conductors.

After a brief introduction, the author gives us in Chapter i. a full and clearly illustrated description of the experimental arrangements used by him, including the various forms of oscillators, resonators and their micrometers, and methods of concentrating the electromagnetic field between wires or plates.

Chapter ii. deals with the methods of measurement. Besides the classical method of determining the sparking distance by means of a micrometer observed either with the naked eye or by the aid of a lens, the author used a resonator with an additional air-gap which was bridged by a battery and telephone receiver. Every time sparks passed across the micrometer-gap, the circuit of the battery and telephone was completed. This method of investigation—which, however, requires very careful adjustment—the author found less fatiguing than that in which the eye is unduly strained in trying to detect the presence of minute sparks.

Chapter iii. describes the methods adopted for adjusting the length of the wires so as to get a sharp division into nodal and ventral segments. This is followed by an

account of the various positions in which the resonator was placed; of the results obtained with an ordinary Hertzian field between two wires, and round a single wire. The author next considers the *interference* field, which is obtained between two wires whose ends are connected to plates placed on opposite sides of the *same* plate of an oscillator. The effects on an ordinary 2-wire field of bending one of the wires so as to lengthen it by $\frac{1}{4}$, $\frac{1}{2}$ and a whole wave-length are next investigated. The author shows that all the effects obtained may be deduced from the results obtained with a single-wire field. An account of some experiments with 3, 4 and 6 wires concludes this chapter.

Chapter iv. deals with the action of the resonator. The effects of varying the position and direction of the micrometer-gap, the disturbance due to the presence of the resonator in the field, and the effect of varying the length of the resonator are studied in detail. The form of resonator with a gap bridged over by a cell and telephone receives careful attention, the effect of altering the position of the gap relatively to the micrometer spark-gap being fully investigated.

Chapter v. is concerned with the important problem of the propagation of waves in dielectrics other than air. Oil and water were the two dielectrics studied by the author, and the effects obtained clear up some rather obscure and apparently contradictory results obtained by other experimenters in this field.

Chapter vi. contains a useful *résumé* of the more important results obtained by the author.

In Chapter vii. the author describes a system of multiplex Hertzian wave telegraphy (*not* wireless), regarding whose practical value we may well be pardoned for feeling somewhat sceptical.

The book forms a valuable storehouse of facts, and the author is to be congratulated on the extremely lucid and well-arranged account of his important researches. They were all carried out on a large scale (in the experiments on oil and water, 230 to 260 litres of the liquid were used), and must have required an unusual amount of skill, care and patience.

A striking feature of the work is the entire absence of mathematical reasoning, not a single symbol of differentiation or integration occurring throughout the whole of the book. The author has carefully avoided all theoretical discussions, and confined himself to an accurate description of experimental facts. The clearness and elegance of the language in which this description is given render it a pleasure to read the book, which will prove a source of delight to every true experimentalist.

OUR BOOK SHELF.

Indicators and Test Papers. By Alfred I. Cohn, Ph.G. Pp. ix + 249. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1899.)

THIS book contains an account of the source, preparation, application and tests for some scores of indicators and test papers which have been proposed for use chiefly in determining the end-point in volumetric chemical analyses. The book opens with a general discussion of the action, use, and theory of indicators, and ends with four useful tables and a good index. The first table is Trommsdorff's showing the sensitiveness of indicators to acids and alkalis, the second is R. T. Thomson's (hitherto the chief English guide), the third is Dieterich's table showing the sensitiveness of various test-papers, and the fourth is a tabular summary of the principal indicators by the author.

The compilation of this book must have demanded much patient labour, and acknowledgments are due to the author for the care and pains he has bestowed upon the work. It will prove a useful addition to analytical literature. Whilst saying this, some points of criticism cannot be withheld. In the first place it must be said that the author has not dealt in a very clear way with the theory of indicators. The subject is not an easy one, and the average operator has not hitherto troubled himself much about it. Litmus has been to him a substance provided by Nature for the discrimination between acids and alkalis rather than the means of furnishing blue alkaline salts from which a weakly acidic substance of red tint is "displaced" by the action of nearly all other acids. Again, the reasons why methyl orange is good for the titration of bases and not of acids is not usually inquired into. Such considerations make it the more desirable that the principles underlying the use of indicators should be stated very clearly. Mr. Cohn has given explanations, including the application of the ionic theory, and of the speculative mechanical theory (somewhat antiquated and unfruitful) of F. Mohr, but he has not set forth the matter with the desirable clearness and coherence.

Next with regard to the substance of the book, it is worth considering whether, in any future edition, type of two sizes might not be employed. Many of the indicators described are of extremely doubtful value, and the worker really wants to know definitely which indicators have been found meritorious by other people than those who have suggested their use. In this connection also a protest must be raised against naming indicators after their inventors. It is useful to know the composition and nine synonyms of Tropæolin OO, but there is surely no call to add to these the term "Von Müller's Indicator."

The book would have been improved by references to original papers. For example, the reflecting galvanometer is scheduled as an indicator, but there is neither a full description of its use nor a reference to Küster's paper on the subject. References would have been valuable throughout the book. A. S.

Optical Activity and Chemical Composition. By Dr. H. Landolt; translated by Dr. J. McCrae. Pp. xi + 158. (London: Whittaker and Co., 1899.)

THIS small book is a remarkably clear exposition of what is a somewhat recondite and difficult branch of chemical physics. It is well known to students of optical science that there are liquids and solid substances in solution which have the strange power of rotating the plane of vibration of a polarised ray of light that is passing through them. Familiar examples are turpentine and other essential oils, sugars, tartaric acid, quinine and albumen. But Dr. Landolt says that more than seven hundred substances, all carbon compounds, are known to exhibit this molecular rotation.

Of course the fruitful discoveries of Pasteur—the right and left-handed tartaric acids, racemic acid, molecular asymmetry, &c., are briefly described; and the more recent simultaneous discoveries of van 't Hoff and Le Bel receive fuller attention. It is shown how this property is met with only where one at least of the carbon atoms of an organic compound is united with four different atoms or radicles; and the results flowing from this kind of structure are explained and illustrated—results which form what is now called stereochemistry.

But the principal object of Prof. Landolt's book, as expressed in its title, is the connection that may be found

o exist between the chemical constitution of a substance and the degree of its rotation. The fact that such relations do exist in the case of other optical properties, such as molecular refraction, dispersion, and magnetic rotation, no doubt gave rise to the expectation that some similar connection would be found in regard to this rotatory power. In the above cases the optical differences depend mainly on the nature and number of the elements composing the substance, though modified to a certain extent by the manner of combination. But here it seems to depend almost entirely on the mode of grouping. Such able experimenters as Guye, Chavanne, Walden, Tchúgaeff, Nasini, van 't Hoff, and in our own country Frankland and Crum Brown, have investigated the question. The problem has not yet been solved; but a number of suggestive results have been obtained which will no doubt lead to further research, and the clearing up of the relationships between composition and amount of rotation which unquestionably do exist.

J. H. G.

Science and Faith; or Man as an Animal and Man as a Member of Society: with a Discussion of Animal Societies. By Dr. Paul Topinard. Translated from the Author's Manuscript by Thomas J. McCormack. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1899.)

THE editors of the *Monist*, some four years ago, invited discussion on the main problems of the philosophy of science and the reconciliation of science and faith. This book is Dr. Topinard's answer—the longest and fullest received—to their question. Man is regarded from the standpoint of anthropology; at the outset a creature merely selfish, but ultimately actuated by the sense of duty to the community. Thus he is a battlefield of opposing influences, egoism and altruism. Can we then explain the development of the latter on scientific principles, or must we have recourse to some external influence or impulse; in other words, assign a part to faith. In a series of chapters the author sketches man's development, as a member not only of the animal kingdom, but also of societies, seeking to trace in the lower forms of life the rudiments both of structures and of ideas. Finally, he arrives at the conclusion that Science and Faith mutually exclude each other. This perhaps would be generally admitted, even by those who would maintain that neither science nor faith alone could give a complete explanation; for each investigates different aspects of the problem and by a different method. Thus far the two are exclusive; nevertheless both may be necessary in order to obtain complete knowledge. For on many minds a problem presses to which Dr. Topinard offers no reply, namely, "Why" is all this? What is the cause of all these phenomena? Of what kind of power are they an expression? To answer this, he might reply, is not the province of science. That may be true, but the question remains, and not a few hold that to ignore it is an arbitrary narrowing of the field of investigation. In other words, whether Dr. Topinard's book will or will not satisfy inquirers is very much a question of temperament. Grant certain postulates—for such they are, and not axioms—in regard to the field of investigation, and it will; repudiate them, and it will not. He maintains "that the two domains of science and faith are two contrary poles"; others will say that each is necessary if a globe is to be complete, and that a very large zone exists between the circumpolar regions in which each of these apparent opposites plays a part, now the one, now the other dominating. But the book is worth reading, whether we are or are not satisfied with its conclusions, whether we regard it as a real or only a forensic success.

Who's Who. 1900. *An Annual Biographical Dictionary.* Pp. xviii + 1002.

The Englishwoman's Year-Book and Directory. 1900. Edited by Emily James. Pp. xxi + 340. (London: Adam and Charles Black, 1900.)

"WHO'S WHO" is now in its fifty-second year of issue and as a handy work of reference containing biographical particulars and addresses of persons of greater or less prominence in science, art, and literature it stands alone. Tested by several years of use, the publication has been proved to be a dictionary of biography which can be referred to with confidence. Science is fairly well represented, every Fellow of the Royal Society from whom particulars could be obtained being included, and also other workers in the scientific world. A complete list of Fellows of the Royal Society is given among the useful miscellaneous information which precedes the biographical sketches. Curiosity induced us to see how many of these names also occur in the list of members of the Privy Council, and we found that although 25 of the 265 members of the Council have been admitted into the Royal Society, only two or three can with the most liberal interpretation be considered as engaged in scientific work.

"The Englishwoman's Year-Book" shows the numerous opportunities which now exist for women to exercise their activities, and testifies to the abundant use made of them during last year. There are fourteen sections, each concerned with opportunities and progress in a particular branch of work, among them being education, medicine, and science. Under the latter head is given lists of scientific articles and papers contributed by women to magazines and learned societies during last year, and also of women science lecturers and demonstrators. The volume should be of service in promoting the best interests of women by exhibiting their intellectual accomplishments.

Le Phenomène de Zeeman. Par A. Cotton. Pp. 100. (Paris: Georges Carré and C. Naud, 1899.)

THIS is the fifth number of the physical series of "Scientia," under which title is appearing a collection of handy volumes dealing with recent advances in science, and intended primarily to enable specialists in one department to keep themselves abreast of the times in regard to the work being done in other departments. A concise account of the Zeeman phenomenon will be valuable to many.

M. Cotton has limited his treatment to the experimental aspect of the phenomenon. He commences with a summary of recent progress in spectroscopy, and of the different causes which tend to modify the spectral rays. The history of Zeeman's discovery is then introduced, and in the next chapters M. Cotton discusses the changes in the rays emitted parallel and perpendicular to the lines of force, and the absorption effects dependent on the Zeeman phenomenon. In the last chapters M. Cotton describes the experiments of Righi, of Macaluso and Corbino, and of Voigt. The author is to be congratulated on the amount of information he has been able to convey in so small a compass.

Dictionnaire des Termes de Médecine, Français-Anglais. By H. de Méric. Pp. vi + 243. (London: Baillière, Tindall and Cox, 1899.)

THE English-French part of this dictionary has already been noticed (vol. lix. p. 484). We hardly see the necessity of giving, in a technical dictionary, the English equivalents of such common words as civilisation, classe, concave, doctrine, division, idée, intelligence, reptile, visage, nuit, and many others. This, however, will not make the volume any the less serviceable to physicians and students of medicine.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Contemporary Meteor-Showers of the Leonid and Bielid Meteor-Periods.

Part II.—Co-Bielid Showers.

AMONG nearly 120 meteor-tracks of the period November 20th–30th, partly seen here in recent years, and partly drawn from the Reports of the Luminous Meteor Committee of the British Association, of the years 1861–80, and among a list of 100 *Bielid*-period meteor-paths observed in Italy, as will be further illustrated and more especially described below, on November 19th–30th, 1897, there were found to have occurred, in this long-past years' collection, 30 *Bielid* meteors and 188 unconformable or ordinary *non-Bielid* meteor-tracks. Several of the former meteors were recorded before the startling discovery in 1872, of the swarm of meteors connected with Biela's comet, had made known the existence of a focus of cometary *Bielid* meteors in this period near γ *Andromedae*; so that several evidently *Bielid* meteors of the list had never before had their true radiant-point, near γ, τ *Andromedae* assigned to them. The great body of *Bielid*-tracks having been subtracted, and the remaining 188 ordinary meteor-paths projected on a planisphere containing all the fifty radiant-points for the *Leonid-Bielid* period, of Mr. Denning's Select List, the paths of all these meteors, without any outstanding very refractory or certainly irreducible exceptions, were found to be satisfactorily referable by trueness of direction joined to suitable descriptions, to one or other of the many radiant-points contained in Mr. Denning's List.

Relative numerical strengths could thus be assigned to many of the fifty contemporary showers, expressing the numbers of meteors traced truly and suitably back to all the best distinguished active sources, among about 30 more or less exactly corroborated radiant-centres. For simplicity the numbers of such meteors per hundred of all the 188 projected ordinary meteor-tracks are noted, to show their relative numerical intensities, against the seven most active of the thus detected ordinary showers which are presented, in descending order of meteor-density or shower-vigour, in the accompanying Table. The percentage strength of the *Bielid* shower itself, which is introduced for comparison with the less productive meteor-systems, is reckoned on the same scale of proportion, to the total number of *non-Bielid* meteors, with that of the slenderer displays, and it only insignificantly outshone the brightest of those contemporary meteor-streams, from no observations having happened to be made, in this collection, in any of the years when the *Bielid* meteor-showers was at a maximum.

The ϵ *Taurid* shower, at 63°, +21°, stood nearly as high as the *Bielid* stream itself, in marked abundance of its meteors. Together with an apparently distinct, but perhaps associated stream of η *Taurids* at about 56°, +18°,[1] this central shower of *Taurids* shows an almost cometary strength and stability of display, approaching in yearly constancy, although not at all in profusion of its meteors, to the showers of August *Perseids*. It produces, moreover, about the middle of November, a notable number of large meteors, and even, as has been proved in one case at least, also detonating fireballs. Its marked superiority over all the showers contemporary with it, only excepting that of the *Bielids*, is easily seen by the slow gradation and comparative smallness of the meteor-frequencies noted in the Table for the next most steady and productive showers. But all these latter streams also considerably outshone the great bulk of weaker streams marked by much fewer numbers of satisfactorily assorted tracks; and their six or seven especially productive *foci* would no doubt, among many showers of very variously interesting and eminent importance in the contemporary List, abundantly repay, in coming years, some further study. To assist discussions by projections of any such new observations, a few less productive radiant-points of Mr. Denning's *Leonid-Bielid* Period List, may even, perhaps, be here mentioned with advantage, although they each furnished no more than four independent meteor-tracks, or 2 per cent. of all the ordinary meteors' paths collected and compared together in the mapped collection.

Taking their numbers and positions as before from Mr. Denning's list of fifty contemporary showers of the *Leonid-Bielid* period, and adding in numbers and mean positions, D('99), of a few shower-series from his extensive General Catalogue of 1899, the following were the recognised centres of divergence of eleven weaker showers (or sometimes of small groups of showers) each contributing about one in every fifty of the whole projected number of ordinary meteor-paths.

1	9° + 34°, π *Andromedae*	seen, almost entirely in 1897.
D('99)39	44 + 57, η *Persei*	
8	48 + 43, $\beta\kappa$ *Persei*	
14	70 + 66, *c*, or α *Camelopardi*; scarcely seen in 1897.	
	And nearer the equator,	
D('99)273	253 + 4, ι *Piscium.*	
D('99)311 and 11	9 + 9, γ *Pegasi* and ϵ *Piscium.*	
5	30 + 16, α *Arietis*	chiefly seen in 1897.
6	43 + 6, α *Ceti*	
D('99)49	53 + 8, *e* or $\xi\sigma$ *Tauri* (three tracks only),	
32	136 + 8, ζ *Hydrae*; not seen in 1897.	

[1] A good display of meteors of this shower was seen this year by Mr. W. E. Besley, at Clapham Park, S.W., on November 8th. Seven bright meteors (and another of 1st magnitude on November 10th), were noted in the short space of 1h. 48m., ending at 12h. 46m. on that night, with a very well-defined radiant-point at 52°, +22°. Their apparent magnitudes in the fixed-star scale were, 4, 2, 1, 1, 3, 2, 1½, 1, and they were long-pathed, slow, trained meteors. Two of the brightest, at 11h. 26m. and 11h. 33m., on November 8th, showed pale green colour in the heads. The meteors of the showers near η *Tauri*, at 56°, +18°, it should be noticed, are chiefly observable in the first half of November, and reach a well-marked maximum of abundance on November 6th–10th; while the ϵ *Taurids*, at 63°, +21°, have an equally distinct date of maximum on about November 20th, and are usually seen in greatest numbers in the last half of November.

TABLE IV.—*Relative abundances of meteors from different ordinary Meteor-showers in the* Bielid *Period, November 20th–30th, among* 188 *ordinary and* 30 Bielid *shooting-stars mapped in some* non-maximum Bielid *nights of the years* 1861–97 *; and relative frequency of the* Bielid *meteors.*

Radiant-point's Number and positon in Denning's *Co-Leonid* List.	[25°+42°, $\gamma\tau$ *Andromedae.*] *Bielids.*	13; 63°+21° $\epsilon\omega$ *Tauri.*	11; 60°+28 ζ *Persei.*	18; 77°+32° $\iota\chi$ *Aurigae.*	17; 74°+15° γ *Orionis.*	7; 46°+21° $\sigma\xi$ *Arietis.*	26; 110°+25° $\delta\kappa$ *Geminorum.*	28; 124°+55° *k Lyncis.*
Numbers of the Shower's Meteors per 100 of all *Non-Bielid* Meteors.	16	12	5 Seen only in 1897.	4½	4½ Seen only in 1897.	3½	3½	2½ Not seen in 1897.
General Appearances of the Showers' Meteors.	Bright, orange yellow, slow; very bushy and spark-tailed; no streaks.	Bright, yellowish meteors; sometimes spark-tailed.	Small, yellowish meteors, with spark-tails.	Yellowish, white; slightly tailed or streaked.	Moderately swift and bright; no streaks.	? White or yellow, tailed; rather bright and slow.	Bright, white, swift; with pretty persistent streaks.	Swift, tapered, brushy meteors, leaving streaks.

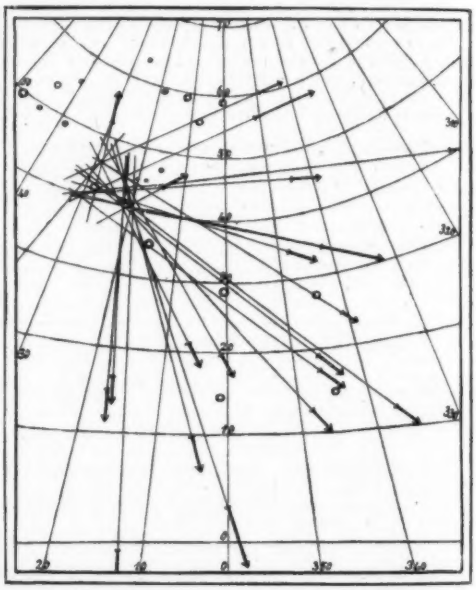
The *Bielid* meteors numbered only about ¼th, and the *Taurids* about ⅛th, of the number of ordinary, or *non-Bielid* shooting-stars; and of the latter divers-centred meteors, the above seven greater and ten lesser ordinary showers supplied together about ⅔ths of the whole meteor number. At the rate of frequency of shooting-stars on ordinary November nights, of about six or seven per hour, it is evident that on such nights, watches would ordinarily have to be continued for six or eight hours to obtain a sufficiently copious path-register of six or seven *Bielid* or *Taurid* shooting-stars, for determining their radiant-points' positions with exactness; and for the less productive showers of which the six stronger and nine weaker ones of the above lists furnished on an average only four and two per cent. of the sundry-centred meteors, watches to record the same numbers of their flights would in general have to be maintained for 25 or 50 hours on successive clear November nights. But as the *Bielid* shower betrays, no weight sufficient to deter observers from attentive watches for them should be attached to most of these showers' low average productivenesses, because they usually appear in sudden rushes of more or less abundant profusion, on no very fixed dates of apparition. Such a marked example of sudden change of strength, seen actually in a single night, appears to have presented itself this year in the *Taurid* meteor-stream, during the preliminary watches kept in the beginning of November for possible forerunners of a coming shower of *Leonids*. No later vestiges at all of the brief shower of seven bright *η Taurids* seen in his watch by Mr. Besley between 11 h. and 13h. on November 8th,[1] were noticeable here in my 2 hrs. watch after 13 h. 40 m. on that night. Only one meteor's path seen here, an exactly true *ξ Taurid*, but 4° distant in its direction from the point near *η* Tauri, among the eighteen meteors mapped in clear sky during those two hours, proceeded backwards from any focal region nearer than 10°–15° to *η Tauri*; and no signs of even diffuse radiation from a considerable space round the shower's radiant-point near *η* Tauri, were shown among the 46 meteor-paths recorded here in my earlier and later watches of 2½–3 hrs. each, on the nights of November 6th and 10th; so that this shower of remarkably bright meteors must certainly, it appears, have been a pretty conspicuous one of very brief duration.

Nor must it be expected that the same showers will be visible every year, in the same strengths, or in the same relative strengths to one another. Such changeful phases of appearance and non-appearance of showers in different years, were well exemplified in the present shooting-star survey, by a fact of great value and help to the collection, that nearly half of its meteor-tracks (100 paths) were observed in a single fortnight of November, 1897, under the clear sky of the Riviera Coast of Italy, by my nephew, Mr. J. A. Hardcastle, who also reduced his own observations and sorted them under their several radiant-points. It thus happens that the radiants marked in the above two lists, of main showers, and of less prominent *addenda*, as only, or chiefly seen in 1897, were not distinguished by more than one meteor, at most, among the earlier set of English observations (the *γ Orionids*, *ζ*, *η* and *κ Perseids*, *α Arietids*, *α Cetids*, and *π Andromedes*); and that on the other hand the *c Camelopardids*, *k Lyncids* and *ζ Hydrids* were scarcely seen at all in November, 1897; while the remaining radiant-points, *γ Andromedae*, *ε Tauri*, *β Geminorum*, *ι Aurigae*, *ε Arietis* and *o Tauri*, *γ Pegasi* and *Piscis*, presented themselves about equally in both the lists.

To correspond with the *ε Taurids*, so plentifully visible on these *Bielid* nights, only a branch shower, apparently, of this main *Taurid* stream, at 68°, + 17°, was noted here, this year, in the beginning of November; and only one (doubly observed) meteor then was recognised as belonging to the active *co-Bielid* meteor-centre near *ι Aurigae*. Similarly a well-focused flight of ten *o Taurids* among 64 ordinary meteors of the earlier watch, produced among about thrice as many ordinary *co-Bielid* meteors, only three meteors from the same radiant-point; and these few distinctions rather than likenesses between the two periods' showers, were the only examples which occurred of either identity or general resemblance in the two periods' stream-directions. But since they all, or nearly all, formed part of a well established contemporary shower list for the middle of November, frequently renewed, well sorted observations would no doubt disclose many distinct continuities of the same ordinary showers from one meteor-period in November to the other, just as the radiant-points extracted for the *Bielid* period from a long series of years were found to agree distinctly in a considerable number of cases, with those recorded in a single year.

Twenty-one *Bielid* shooting-stars were among the 100 meteors mapped at Alassio in November, 1897; and in a projection of his observations which was then made by Mr. Hardcastle on one of Prof. Lorenzoni's gnomonic polar nets, these are shown in the adjoining map, diverging from near *τ*, *υ* and *γ Andromedae*. Of the two maxima of frequency or of hourly rate of appearance, shown at the foot of the map, which they seem to have presented on November 23rd and 26th, the first agrees closely with the date of the shower's last bright return on November 24th, 1892; while the second seems to be a still-lingering remnant of the older date of the stream's returns, on November 27th, in 1872 and 1885, before the meteor-cluster's node was shifted backwards 4°, as Dr. Bredichin has proved, by

Paths of 21 *Bielid Meteors observed at Alassio, Italy, November 19th–27th, 1897, by J. A. Hardcastle.*



Dates, 1897, November	19	20	22	23	24	25	26	27
Duration of Watch, in clear sky	2h.	2h.	3h.	2½h.	3h.	¾h.	1½h.	2h.
Numbers of Bielids mapped ...	1	3	4	5	3	1	3	1
Numbers of Bielids per hour ...	0·5	1·5	1·3	2·0	1·0	1·3	2·0	0·5

strong attractions of the planet Jupiter on the meteor-swarm in the year 1890. No large action of Jupiter on the swarm, it has been shown by the late Dr. Abelmann,[1] would afterwards occur again until the year 1901, when another near approach of the cluster to the giant planet will shift the node backwards 6°, and make the date of the shower's next expected great return November 17th, 1894 or 1895. On the two occasions of the earth's passage through the node on November 23rd or 24th, in 1898 or 1899, Mr. Denning has conjectured that the earth would first pass in front of and then behind the cluster, thus escaping a very central passage, which might, in that case, however, be expected to occur, with the comet's periodic time of revolution of 6½ years, with near enough exactness for a great display, on November 17th, 1905. But as watches for the *Bielid* star-shower, at the present nodal passage will now no doubt have been kept attentively at many stations well favoured, if not very generally in the British Isles, by clear sky and fair weather for observing both the *Bielid* shooting-stars and other meteors, these recent meteor-notes may perhaps usefully suggest

[1] Referred to in the *Note* on p. 271, as apparently a very important observation of a meteor-shower, from the brightness and very perfect radiation of the meteors, and from the clearness and accuracy of their paths' descriptions.

[1] *Astronomische Nachrichten*, No. 3516, September; and *The Observatory*, October 1898.

some trial radiant-points for any remarkable shooting-stars or large meteors of the two past years' expected maximum *Bielid* periods which may have been recorded.

Observatory House, Slough, A. S. HERSCHEL.
December 16th, 1899.

Is New Zealand a Zoological Region?

WILL you allow me to make one remark on the letter of Mr. H. Farquhar (p. 246), advocating an affirmative answer to the above question. It is this: Throughout the whole argument there is an assumption which vitiates it, namely, that the amount of resemblance of the New Zealand fauna to that of *Australia* is what alone determines its resemblance to that of the *Australian Region*.

Apparently, Mr. Farquhar does not believe that New Caledonia and the New Hebrides belong to the Australian Region, otherwise he would not adduce the fact of the land-shells of New Zealand being related to those of the above-named islands as an argument in his favour; and if these are omitted, then must New Guinea be also omitted. And if Australia by itself is to become a "Zoological Region," New Guinea and its surrounding islands must be also a "Region," the Central Pacific Islands another, and the Sandwich Islands yet another! This indicates the difficulties that arise if the Australian Region, as originally defined by Dr. Sclater and myself—and which I still hold to be far more natural than any subdivision can make it—be rejected.

ALFRED R. WALLACE.

Molecular Structure of Organised Bodies.

PROF. VINES, in his "Physiology of Plants," says that the molecular structure of cells can only be inferred from their properties, and that a correct conception of this structure is essential for a proper comprehension of cell growth. In the same work the author also states that Naegeli argues: "Since the optical properties of these organised structures are apparently not dependent, like those of a crystal or a piece of glass, upon the relative position of their constituent particles, they must be inherent in the particles themselves. Each micellæ, then, possess the optical poperties of anisotropic crystals. Naegeli concluded, therefore, that the micellæ are crystals."

Naegeli's micellæ theory rests almost entirely on the failure of any effort to temporarily destroy the anisotropism of organised structure. Obviously, if it were possible to so act on or swell a vegetable fibre that its anisotropism were destroyed, and that this anisotropism returned after the treatment were discontinued, Naegeli's theory, as far as it relates to the optical properties of micellæ, would fall to the ground.

It is well known that organised structures cease to be doubly refractive at the moment when their organised structure is destroyed. This is usually explained by saying the micellæ are at the same time disintegrated.

As far as I am aware, it has never been shown that this property of double refraction, common to organised structures, can be destroyed by suitable swelling, and restored again when the body returns to its original condition. I have been able to do this, in the case of cotton fibre, and it seems to me to give the *coup de grace* to Naegeli's theory.

I take it that if in one instance the anisotropism of organised structure can be temporarily destroyed, it is a correct inference, that to do so in every case only requires a suitable medium; which will reduce the strains to a necessary degree without the destruction of the physical form of the organised structure.

In the course of some investigations on the destruction of nitro-cellulose fibres, by means of solvents, I observed that in one particular case the double refraction disappeared long before the physical structure, and that on getting rid of, or diluting the solvent, the anisotropism returned. It is because I think this observation will be of interest to biologists I am troubling you at length.

It is well known that on converting fibrous cellulose into nitro-cellulose, the fibres retain their optical properties as regards polarised light. Nitro-cellulose, however, has a very wide range of solvents, and the examination of organised fibres when treated with solvent, becomes very extended.

Most nitro-cellulose solvents, such as acetone, nitro-benzene, the ethers, &c., do not lessen the anisotropic properties. The fibres may be swollen to twice their diameter, but still polarise light, until their physical structure is quite gone. This is not so, however, if nitro-cellulose fibres are acted upon with a mixture of acetone, benzene and ethyl alcohol. With this solvent the nitro-cellulose becomes gelatinised, and the anisotropism disappears, yet on examination the fibres are seen to be present in great abundance. These isotropic fibres can be given their double refractive properties again, by diluting the solvent with excess of alcohol or benzene.

The accompanying photographs show this action very well.

Nitro-cellulose was prepared from cotton-wool, with large excess of acids, so that there should be no unnitrated fibres present. The resulting nitro-cellulose was practically all of the

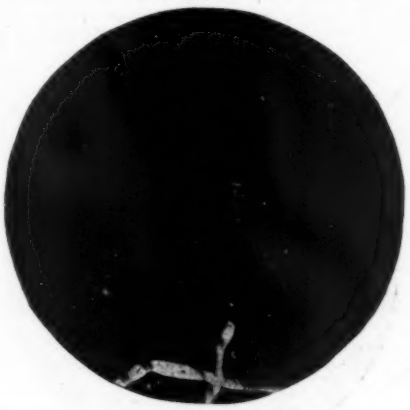


FIG. I.

insoluble variety, and contained 13·3 per cent. nitrogen. It wa completely soluble in excess of acetone, and contained no cotton fibres.

Some of this nitro-cellulose was treated with ten times its weight of a solvent consisting of:

6 parts benzene
3 „ alcohol
2 „ acetone

and allowed to stand in a stoppered bottle twenty-four hours, a jelly resulted.

FIG. II.

Figs. I., II. and III. are from a little of this jelly, mounted with two crossed cotton fibres to fix the point of view, and give an object to focus and develop. The three photographs are taken from the same slide and the same point of view.

Fig. I. is a view under crossed nicols of the jelly, and taken immediately after mounting. It will be noticed that the object shifted slightly during exposure.

Fig. II. is the same view, taken immediately after I., but with the polariser opened a little.

Fig. III. was taken after the slide had been treated with Canada balsam and benzene, and allowed to stand five days fixed in the microscope. The benzene and Canada balsam gradually diluted the solvent and brought back the anisotropism of the nitro-cellulose fibres.

The magnification in all photos was × 50 diameter, and the exposure in I. and III. was in each case twice that of II.

In Fig. I. it will be observed that a little light is active besides the crossed cotton fibres. This is more noticeable in the negative. As a matter of fact, with this strength of acetone the anisotropism is just evanescent in a percentage of the fibres.

A comparison of Figs. II. and III. shows that nearly all the fibres seen in II. are anisotropic in III. The fibres obvious in

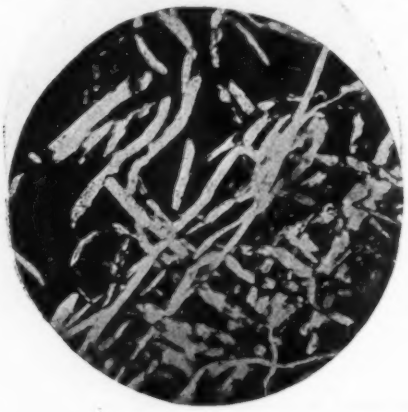


FIG. III.

II. and not evident in III. lie in the plane of polarisation. The fibres obvious in II. and III. are isotropic in I.

I leave the correct interpretation of these experiments to competent biologists. To me it seems probable that the anisotropism of fibrous cellulose is due to a strain put on the fibre by the tension of the most outward layer of the cell-wall, and that a medium such as here described lessens this tension, whereas ordinary inhibition does not. Some such a theory as the above seems necessary to account for the different action of solvents which swell organised structures. This view is a modification of Strasburger's theory, as I understand it, and would be independent of whether cell growth takes place by lamellæ or particles.

F. W. JONES.

Barwick, Herts.

School Science and Knowledge-Making Power.

THE lecture of Prof. J. G. Macgregor, as reported in NATURE, of December 14, is of very great interest to science teachers, more especially to those in secondary schools. It will afford great comfort to the still very large number of controllers of the curricula in such schools who do not really sympathise with, nor believe in, the good results obtained from scientific teaching. As one who has to deal with all ages of pupils in a large school, may I be allowed to make a few comments on Prof. Macgregor's lecture as it strikes a science teacher?

In class work it seems that the lower forms, when watching an experiment performed before them, are quicker to put one thing with another, and to be led to explain or suggest explanations of the results obtained. This is apparently in accordance with Prof. Macgregor's opinion, that younger pupils have a greater knowledge-making power.

Thus a class of boys, whose ages range from seven to nine years, is much more ready to ask and answer questions concerning the subject of the lesson than classes towards the middle of the school.

The reluctance shown, or the difficulty felt, by higher classes in answering or suggesting questions is considered by Prof. Macgregor to show a lessened power of knowledge-making possessed by them. But even if the science teaching is, throughout the forms, of a constant character in its aim of bringing out the inquiring spirit, in my own experience the same thing is noticed. Can there be another explanation? As boys grow older they are more careful not to make such mistakes in their verbal answers as would lead to the slightest ridicule on the part of their class fellows. Thus, by remaining silent, they give one the impression that they are not following the work with the ability shown by their juniors. Again, with increased experience, questions do not appear so simple in their nature; alternative explanations are suggested to the boy's mind, and the choice is difficult to make. It is possible that the few suggestive solutions offered by a higher form show more power than the many more obvious ones given by the lower form.

Prof. Macgregor says that at present Latin is the only subject which really brings out this knowledge-making power. Surely this is comparing the results obtained from the best classical teaching in small selected forms where each boy is really known to have done his work to the very best of his ability, with the results from science teaching of a very old-fashioned kind, in which the lesson, given to a large class, is of the nature of a lecture. Such a comparison may be made to the disadvantage of any educational subject. It is still the custom in some classes to learn Euclid's propositions by heart! Yet no one would think of displacing the subject on this account.

Referring to the difficulties of increasing the knowledge-making powers of boys, certain enemies are mentioned. There is the use of synoptic or cram-books, which has been found to be necessary to push pupils through examinations in which "knowledge is power" is held as the maxim. Such books, after all, only take the place of written notes of lectures given to the highest forms, and have the advantage of saving the pupil's time. Further, text-books do not all consist of this kind of publication; in fact, some of them are as interesting to an intelligent boy as one of the ordinary run of story-books. Properly used, text-books are of great value surely in this way: the whole attention of the scholar is directed to the demonstration, and after the lesson the book is used to refresh the memory, which it does, not simply by repeating the results, but also the deductions from the results and the necessary steps of reasoning involved.

Prof. Macgregor objects to text-books which contain details of practical work to such an extent that the pupil is told what to do, what to expect, and the reasons why. If the teaching is carried out under such a system as that referred to as the Heuristic, then in the practical text-book it is not necessary to include all these details, but some appear to me to be absolutely necessary. Teachers know well enough the difficulty of getting printed instructions accurately carried out; and certainly letting even a small class of moderately steady boys loose into a laboratory would give the controller of the laboratory an anxious time. If, then, instructions are needed, why not print them? They must otherwise be written on the blackboard, or be of a verbal nature—the latter involving many repetitions.

The best chance that practical science (of course, commenced as early as possible) has of producing knowledge-making power, appears to be in the opportunity it affords of solving questions in a manner closely following an experiment previously carried out. In this connection modern science teaching combines the advantages of the study of propositions in geometry and riders thereon, with employment, simultaneously, of brains and hands. Now an experiment previously carried out implies instructions given.

The other enemy referred to by Prof. Macgregor is the examination syllabus. It is certainly difficult under the best of circumstances for a teacher to go completely through, say, the Cambridge local examination syllabus in science on the Heuristic system, in the time usually allowed by school time-tables. With such a task in front of him the teacher is bound at times to descend, so to speak, to dogmatic teaching. The modern syllabus, both in this examination and in that for the London matriculation, covers so wide a ground that there is danger of the work becoming of the same character as it is said to have been under the older syllabuses. It would appear, even now, to be absolutely necessary to use "synoptic books" when such lengthy syllabuses are prescribed and written examinations held.

But it is hard to see how even a practical examination can test the knowledge-making power of boys when a lapse of

memory may prevent the performance of a measuring experiment, *e.g.* in the recent Cambridge local examination one simple question, to find the area of an ellipse by two methods, is a very admirable question, but presumably one-half the marks allotted are lost should a candidate forget the formula πab.

And, again, it was required to find the specific heat of a liquid by a non-mixing method. Why should this restriction have been made? The practical exercise is sufficiently difficult without any restrictions as to the process employed.

It is only fair to the science teachers in schools to call attention to this side of the question of knowledge-making power in boys, and, instead of merely saying that few teachers have the necessary inspiring spirit, to point out the hindrances with which they have to contend, as Prof. Macgregor has done.

G. H. WYATT.

Emmanuel School, Wandsworth Common, S.W.

Echelon Film Gratings.

MANY of your readers will doubtless be interested to learn that Mr. T. Thorp, of Manchester, who has so successfully reproduced copies of Rowland's gratings, has been able to make an "Echelon" grating on the principle suggested by Prof. A. A. Michelson last year, but stated to be well-nigh impossible on account of mechanical difficulties. The success of the operations depends on the shape, depth, and spacing of the grooves, and after many calculations and preliminary trials Mr. Thorp finds he can produce echelon films throwing the *whole* of the light into the first, second, or other requisite order, the direct image being practically suppressed. The first successful films made in this way were obtained in November last, and it is hoped that in a short time several will be available for examination. If permanent, they should be capable of giving star spectra with the same facility as prisms.

Royal College of Science, S.W. CHARLES P. BUTLER.

The Stockholm Fisheries Conference and British Fishery Investigations.

IN my letter published in NATURE of January 4, I attributed to the Government a larger grant in aid of the fishery investigations of the Royal Dublin Society than was actually given. My friend Mr. Holt informs me that, of a total sum of 2800*l.* originally provided for the work of the Marine Laboratory for five years, the Government only supplied one-half, viz. 1400*l.*, the remaining 1400*l.* being voted by the Society out of its private funds. It being found impossible to carry out the work satisfactorily with such small funds, the Society has recently voted a further sum of 500*l.* for the purchase and equipment of a fishing boat. My contention that existing institutions should be adequately supported before Government money is employed for starting a new organisation is therefore considerably strengthened.

E. J. ALLEN.

The Laboratory, Plymouth, January 12.

THE REPRESENTATION OF THE UNIVERSITY OF LONDON.

IT would seem that the University of London is in some danger of missing a great opportunity in connection with the vacancy created in its representation by the elevation of Sir John Lubbock to the Upper House.

Our readers need not be reminded that the theory on which the representation of academic bodies in Parliament is based is often assailed by politicians and thinkers, and is only tenable on the assumption that those bodies may be trusted to select persons of special eminence in science or learning, and qualified to obtain the confidence of the nation as representatives of its higher educational interests. This principle has been kept in view by Dublin in its choice of Mr. Lecky, by Cambridge and Oxford in the choice of Prof. Jebb and Sir W. Anson, and by the University of London so long as it was represented by Mr. Lowe and Sir John Lubbock. Unless men of higher intellectual rank than mere politicians are sent to the House of Commons by the Universities, there would no longer be any *raison d'être* for University representation at all, and in a democratic community the privilege would not be likely to survive long.

It appears now that there are two small Committees—the one Liberal and the other Unionist—which seek to control the Parliamentary elections of the University; and that on this occasion, instead of heeding the larger public interests involved in a University election, each caucus has been content to nominate one of its own active members, though wholly unknown to the learned and scientific world, or indeed to the general public.

Dr. Collins, the nominee of the Liberal party, took a very distinguished degree in medicine and surgery; has been prominent in the domestic controversies of Convocation, and has been for a time a member of the Senate. Outside of the University he is known as a man of great ability and promise, who achieved marked success as Chairman of the London County Council. But he is considered very unlikely to secure the adhesion of the medical or the scientific graduates.

Mr. Edward Busk, the Unionist candidate, is less known to the outer world. He has a creditable reputation in his own profession as a solicitor, and also as Sir John Lubbock's election agent. As chairman he has paid assiduous attention to the meetings of Convocation and of the annual committee: and has come to be regarded by a certain section of the members—especially by those who opposed the recommendations of the Royal Commission and the University Act—as in some way a guardian of the interests of the country graduates. But his supporters do not claim for him that either in the departments of scholarship and science, or in general academic or educational politics, he has yet evinced any interest or is known to possess any authority or influence.

The fact that both of the Committees, with their special command of electioneering apparatus, have been able to gain a start in point of time, and in some cases to secure provisional pledges, ought not to conceal from the general body of graduates the gravity of the present crisis, or prevent them from acting with due care and circumspection and a strong sense of responsibility in the choice of their member. The truth is that neither of the candidates selected by the named party organisations is of the *calibre* required to fill the seat of Sir J. Lubbock. The election of either would lower the reputation of the University as a learned body, and bring serious discredit on the principle of University representation itself. This has been pointed out with strong emphasis in letters and a leading article in the *Times*, which it is reasonable to expect that the graduates will not fail to consider with attention.

It is to be hoped that before the seat is actually vacated the name of a distinguished graduate may be submitted to the electors—a name not associated with any party politics, but commanding high and general confidence in the scientific and learned world.

ZOOLOGY AND THE AUSTRALIAN MUSEUMS.[1]

ALL who are interested in Mammalian Palæontology and exploration in the Interior of Australia will readily recall the graphic account contributed to our pages in 1894 (NATURE, vol. l., pp. 184 and 206), by Prof. Stirling, of the work of an exploring party sent out to Lake Callabonna, under the auspices of the South Australian Museum, of which he is the Hon. Director, for the purpose of collecting the remains of the gigantic vertebrates of Pliocene age known to be there entombed.

1 "Memoirs of Royal Society of South Australia," vol. i., Part 1. By E. C. Stirling, C.M.G., M.A., M.D., F.R.S., and A. H. C. Zietz C.M.Z.S.

"Fossil Remains of Lake Callabonna." Part 1. Description of the Manus and Pes of *Diprotodon australis*. Pp. 40 + 18 photographic plates.

The lake, known as Lake Mulligan until, at Prof. Stirling's instigation, its name was changed (as he himself informed us at the Zoological Society, on the occasion of his last home-coming), presents conditions wholly unfavourable for successful preservation of organic remains, owing to the action of a saline infiltration. The skeletons of the monsters which there lie are found some four feet beneath the surface mud, spread out in positions indicative of "death *in situ* after being bogged," the creatures having crowded down, as the area available for food and water gradually diminished under the influence of climatic change—the whole looking, as Prof. Stirling has aptly remarked, "a veritable necropolis of gigantic extinct marsupials and birds which have apparently died where they lie."

The name *Diprotodon* was applied by Owen in 1838 to a piece of a jaw, discovered in the Wellington Caves, and a considerable accumulation of material from various localities enabled him nearly forty years later (1877), in his "Fossil Mammals of Australia," to diagnose the genus and more fully describe the greater part of its skeleton and dentition, with the exception of the manus and pes. He admitted one good species (*D. australis*), and in the meantime (1862) Huxley had founded another (*D. minor*). Beyond this, our knowledge has been until recently confined to sundry scattered descriptions of odd teeth and bones, some of the latter having been apparently confounded with the limb bones of Chelonians and other reptiles and mammals. Our greatest desideratum therefore concerning these animals has been a knowledge of their pedal skeleton, and it is precisely that which the present memoir makes good. Moreover, the fact that while the living Diprotodont Marsupialia, with the exception of the South American *Coenolestes*, are all Australian, recent exploration in the fossiliferous beds of Patagonia has, according to Moreno (*cf.* NATURE, vol. lx. p. 396), revealed the presence of remains, if not of the genus Diprotodon itself, of near allies, invests both this genus and the present memoir with a very special interest, as involving the question of former inter-relationship between the great continents, now a burning topic of the times.

The material, as already stated, was discovered in a state unfit for preservation and removal; and Mr. Zietz, who has been chiefly concerned in its transport and subsequent treatment, by judicious use of glue and isinglass, has succeeded in so successfully preventing its disintegration, that Dr. Stirling was enabled to bring with him in 1897 for exhibition before the Zoological Society some bones of the large extinct bird *Genyornis* which they had then just described; and those who were so fortunate as to see them will recall their condition as a triumph for the preparateur's art. Some idea of the additional difficulties which had to be overcome, and of the tax on the patience and endurance of the authors in the field, may be formed from the description they give of a "Diprotodont skull-mass," which, dried and prepared, with its matrix, weighed close upon 2 cwt., and from the fact that when their booty was packed ready for transport their camels would start operations by getting "bogged to their bellies in crossing the strip of lake-surface which intervened between the working camp and the nearest solid land, unloading being a necessity, before extrication" and resumption of the 200 mile tramp which lay beyond.

These difficulties overcome, five years' continuous work has enabled the authors to make known their results, and so important are these esteemed by the Royal Society of South Australia that they have founded a special series of memoirs (of which that under review is the first) for their publication as the materials are worked out.

Dealing, first, with synonymy, the authors, in a preliminary statement concerning dental characters, admit Owen's *D. australis*, and incline to the belief that Huxley's *D. minor* may be identical with their smaller species; while, concerning a probable third species, somewhat larger than this, they reserve fuller consideration for a future memoir. Owen's *D. Bennettii* is dismissed with a passing comment.

The main portion of the memoir is devoted to a description of the pedal skeleton, fourteen examples having in all been obtained. The figures and descriptions are based upon dissociated remains, no single member having been found wholly complete in itself. The bones of the right side are for both fore- and hind-limbs, each delineated as a whole in one plate, as here reproduced except for a slight modification in the lettering, the remaining sixteen plates being devoted to the representation of individual bones in aspects necessary for their full study, as described in detail in the text.

Concerning the fore-foot (Fig. 1), the authors state that the radius completely crosses the ulna, and that there is a special radio-ulnar articulation formed, to admit of supination. Typically marsupial are the relationships of the

FIG. 1.—*Diprotodon australis*, skeleton of right fore-foot, dorsal aspect, ¼ natural size.

pisciform (*p.*) and cuneiform (*cn.*), which are massive, and together furnish a deep concavity for the ulnar condyle. Trapezium (*tm.*), trapezoid (*td.*), magnum (*mg.*), and unciform (*un.*) are all present. Interest chiefly centres for the fore-limb in the identification of the preaxial proximal carpal element (*sc.*) (regarded by Owen as a scapho-lunar) as the scaphoid, the term "scaphoid sesamoid" being applied to a small bone which (*s.s.*) flanks its lower free border with which it is apparently in articulation. Concerning this our authors are very brief, but we venture to think that, in view of the recent researches of Pfitzner and Forsyth-Major, the validity of their interpretation may be open to doubt; and we would recommend to their consideration Emery's memoir on the development of the marsupial limb-skeleton (in Semon's "Forschungsreise")—the best piece of work on the subject during recent years.

Both fore- and hind-limbs are pentadactyle, the digits of all five in front and of all but the hallux behind

terminating in ungual phalanges. Passing to the hind foot (Fig. 2), the most superficial glance at once proclaims it a marsupial limb, begotten, as Huxley has so strongly argued for that of the order (in which he has been recently supported by Dollo), of an arboreal type. The fixation of the sole remaining element of the hallux (1) in extreme abduction, the slenderness of the digits 2–3, suggestive at first sight of syndactyly, are among its most conspicuous features; indeed, our authors believe the latter process to have involved even the fourth digit as well, but of this we do not see the proof. The immense proportions of the calcaneum (*ca.*), and the surmounting of this by the astragalus (*as.*) which alone furnishes the ankle joint, are conspicuous features of this very remarkable limb; but that which is most striking is the enormous expansion of the fifth metatarsal (5) to an extent unparalleled by any other known marsupial form, that element being so modified as to furnish a base of support for the outer border of the limb. *Diprotodon* is further unique among all known marsupials for the like

FIG. 2.—*Diprotodon australis*, skeleton of right hind-foot, dorsal aspect, ¼ natural size.

modification of its corresponding metacarpal (5, Fig. 1). As concerning the hind-limb, the inward and upward enlargement of the navicular (*nv.*), which the element termed by the authors entocuneiform (*ms. en.*) is seen to have also undergone, would seem to us to suggest a similar supporting function for the inner border of the limb, and to explain the presence of only the tarsal element of the hallux (1) in its greatly developed form—that bone and the inner lobe of the navicular being apparently together specialised for purposes of support. And we are led to surmise that in this there may lie the clue to the reduction of the middle digits, rather than in a supposed syndactyly.

Considerable interest attaches to the discovery of an *os trigonum*, wedged in between the tibia and fibula and the astragalus. It is unfortunate that our authors term this the "os pyramidale," apparently by comparison with the "pyramidale," discovered by Owen in the Wombat, to which they do not however allude. To it the comment we have made on the "scaphoid sesamoid" may equally be applied. But two cuneiforms are described as separate elements in the text and indicated in the plates, labelled ecto- and ento-cuneiform respectively, thus leading to the supposition that the meso-cuneiform may be absent. The authors, however, point to details which justify their regarding the latter bone as a compound (as indicated in our revised lettering) of the ento- and meso-cuneiform, in itself a unique feature of the genus; and it is a great pity that this is not rendered evident on the plates, in which the lettering indicative of the ento- is placed on the meso-cuneiform, to an utter confusion of ideas.

Beyond this we have no remarks which are critical, and we reserve comment on the authors' views concerning the position of the genus in the marsupial series until their later memoirs appear. Certain it is that the possession of these magnificent remains will render the South Australian Museum famous, in the manner that the Munich Museum is for its Pterodactyles, the Brussels for its Iguanodons and Mosasaurs, the Yale for its Ungulates and Toothed Birds; and we consider it incumbent on the authors, having so successfully overcome the difficulties of transport and preservation, that they will close their series of memoirs on Diprotodon with a careful reconstructional drawing of the entire skeleton, and render it possible, in the interests of science, for others to obtain a corresponding papier-maché restoration, as has been so successfully done with Marsh's Dinocerata, or a cast, as with Dollo's Iguanodons.

Upon the acquisition of these treasures our Australian *confrères* are to be congratulated; and it is opportune to point out that the event marks but one of a series of recent great advances in our knowledge of the unexplored interior of that continent, in which Prof. Stirling has played a not unimportant part. Chief among those, however, whose names will live in the annals of later Central Australian investigation is his co-explorer, Prof. Baldwin Spencer, of Melbourne. Of his scientific attainments and enterprise, as exhibited in his conduct of and contributions to the Horn Expedition, and his recently published book in conjunction with Mr. Gillen on the Arunta Tribes, no praise can be too high. Not content with this, he has recently accepted office, in succession to the late Sir W. M'Coy, as Director of the Melbourne Museum; and in so doing, to his brilliant reputation as a teacher, scientific investigator and explorer, he has added fame as a Museum Curator, for, fired by a whole-souled enthusiasm which has characterised his previous acts, he has foregone remuneration and taken office as Hon. Director, in order that the money available may be applied to bettering the position of the assistant he found in charge, and the providing of additional aid in the momentous task of reorganisation upon which he has resolved. He thus becomes at once a Trustee and Hon. Director, and using his influence with the Government, he has already obtained a grant of 13,000*l.* for building purposes, and has in course of construction a spacious hall of some 150 + 110 feet in area. The collections, rich both in materials and literature, have been found to include three of du Chaillu's original adult gorillas, an entire *Nestor productus*, a very fine Aepyornis egg, a good series of Antelopes, and a ninety-foot Whale's Skeleton. Already a considerable rearrangement has been effected; a group of giraffes, a case of lyre birds with nest and dancing ground, another of megapodes, of albatross with the parent on a genuine nest, all mounted after the fashion of the exhibits in our own Natural History Museum (amidst natural surroundings, as was first done for birds in the famous Booth collection at Brighton), are examples foreshadowing a complete transformation, under which a geographical arrangement will give place to a zoological and more scientific. The cases are, however, lacking in Australian

materials. These Prof. Spencer intends to secure with all possible speed, and to that end he is already laying plans for renewed exploration of the Bush and the Interior. It is his intention to make the museum at once a thoroughly representative Australian Collection and a great Educational Institute. In this he has a labour of years; and that he will succeed we have not the slightest doubt, for pluck, endurance, far-sightedness and enthusiasm are in him unusually combined.

The work of the Sydney Museum has rapidly developed in interest and importance during recent years; the introduction of "new blood" there, as more recently at Adelaide and now at Melbourne, has brought to bear upon the investigation of the indigenous fauna and the natural resources of the country, now so largely dying out, a body of earnest students intent on work while yet it is not too late. The present memoir, which is an outcome of this movement, may thus be regarded as a sign of the times; and we sincerely hope that those which are to follow will be pushed forward with all possible speed, it being now five years since the discovery of the remains of which it treats was announced.

FLOATING STONES.

DURING my recent visit to South-West Patagonia, in 1899, for excavations in the remarkable Glossotherium or Neomylodon Cave near the farm Puerto Consuelo or Eberhardt, I made, with my fellow traveller, Dr. O. Borge, the following curious observation. Whilst rowing in the long and narrow channel of Ultima Esperansa, to study the plankton, we observed, when the sea was calm or only agitated by a slight swell, small fragments of slate which floated upon the surface packed together in larger or smaller clusters. They drove hither and thither in the neighbourhood of the shore, until they were driven away by the strong current which at intervals swept forward in the channel. The quantity was considerable; for instance, 700 of them were obtained at one cast of the net in a few minutes. The stones had evidently drifted out from the beach, which consisted mainly of similar stone fragments washed off from the cliffs composed of a bituminous mesozoic slate. The surface of the stones was dry, and they sank immediately when it became wet by touching or by the movement of the swell.

Fragments of slate found floating upon the sea-surface at S.W. Patagonia.

The slate fragments collected on the sea-surface had a specific gravity of 2·71. The specific gravity of the water in the channel was only 1·0049 at a temperature of 15° C (59° F). The largest stone which I obtained from the surface (pictured in natural size on the accompanying zincotype) weighed 0·8 gram. Twenty of the smaller fragments had a mean weight of 0·3 gram. The fragments contain no air cavities perceptible to the unaided eye. They must, therefore, not be confounded with the volcanic ejections (and perhaps slags from meteors) with its numerous air cavities which are often found drifting on the surface of the ocean.

The following consideration will help to explain the apparently paradoxical fact that stone fragments of a specific gravity of 2·71 and a weight up to 0·8 gram have been observed floating on a fluid of a specific gravity of 1·005. On examining the floating stones one could discern small gaseous bubbles attached to the under surface of them, and at the shore stones can be seen on the very fringe of the beach which are just beginning to float lightened by gaseous bubbles. Unfortunately, I had not occasion to investigate the conditions more closely, as I was busy with other researches; neither had I any apparatus at my disposal for the collection of the gas that had accumulated under the stones. It is probable that the stones were not only provided with gas bubbles, which can be perceived by the eye, but that they were surrounded by an envelope of gas supported by an insignificant coating of algæ, of which the stones are surrounded. At least, traces of diatoms and algæ are discernible on the stones after drying. The greasy surface of the mineral of which the floating stones consisted also prevented the water from adhering to them, and caused the stones to be surrounded with a concave meniscus, which naturally may have contributed to, and perhaps was the main cause of, their floating, which sometimes was further facilitated by a patelliform shape of some of the bigger stones.

The observed phenomenon is not without some geological interest. In the described manner a considerable transport of solid matter takes place, not only in the narrow Patagonial channel, but no doubt also at several other shores of the ocean; and new strata will be built up possibly enclosing mixture of remains from far distant geological periods.

ERLAND NORDENSKIOLD.

DR. ELLIOTT COUES.

BY the death, on Christmas Day, of Dr. Elliott Coues, America loses one of its leading ornithologists; indeed, we may say, without disparagement of others, the most prominent since Spencer Baird was taken from us. Born in 1842, at Portsmouth, in New Hampshire, and graduating in the Columbian University, Coues entered the medical service of the United States Army in 1862, receiving the brevet rank of Captain for his conduct during the war, after which he held several appointments of various kinds, and especially one in Arizona, which gave him the opportunity of indulging his inborn taste for natural history. Subsequently he held in succession the posts of Professor of Zoology in the University of Norwich, in the State of Vermont, of Anatomy in the National Medical College at Washington, and of Biology in the Virginia Agricultural College, besides being, in the interim, surgeon and naturalist to the United States Northern Boundary Commission, and from 1876 to 1880 secretary and naturalist to the United States Geological and Geographical Survey of the Territories. The duties of these different offices seem only to have stimulated his efforts, and the number of his zoological papers contributed to various scientific journals would alone accord him a high place; but, apart from them, his "Birds of the North-West," his "Fur-bearing Animals," and "Birds

of the Colorado Valley," to say nothing of his "Key to North American Birds"—of which a third edition was announced for the ensuing spring—and his "Ornithological Bibliography," each a model of accurate work, proclaim him to have been far in advance of any other contemporary of his own country, or indeed of many others. In the summer of 1884 Dr. Coues visited England, to the great satisfaction of British ornithologists, to most of whom he had been only known by name, for thus his attractive personality attached to him many warm friends. After taking a considerable share in the publication of the "Century Dictionary," of which he was the Natural History editor, he latterly turned his attention to some of the earlier geographical explorations of his own country, and we owe to him admirable editions of the "Travels" of Lewis and Clark, and of General Pike.

Last summer Dr. Coues revisited Arizona, intent on ethnological researches, but found a camp life at the elevation of 7000 feet too much for his powers. Returning to Washington in the autumn, distressing symptoms of a serious ailment soon began to show themselves, and in a touching letter to an English friend, written at the end of November, he announced that the only hope for the prolongation of his life lay in the success of a very formidable surgical operation which he was about to undergo in the Johns Hopkins Hospital at Baltimore. The last mail brought the sad news of its failure, and the ornithologists of Britain will assuredly condole with those of North America in the loss of the most accomplished of their brethren. A. N.

NOTES.

IN calling attention to the article in another column concerning the future representation of the London University in Parliament, we may state that there is a very widely expressed feeling that such representation, being a matter of national concern, should be considered from an absolutely non-political standpoint. A strong feeling has been expressed in many quarters that if the representative of the University be not a man of European distinction, a great opportunity will have been lost. Among those thought of from this point of view is a distinguished office bearer of the Royal Society. We trust that if he has been asked to serve in such a cause, he will not refuse to come to the assistance of those who are working to promote it.

PROFS. DARBOUX AND MOISSAN have been nominated to represent the Paris Academy of Sciences at the forthcoming celebration of the second centenary of the Berlin Academy of Sciences.

THE Council of the Royal Astronomical Society have awarded the Society's gold medal for this year to M. Poincaré, for his researches in celestial mechanics.

THE Municipal Council of Paris have adopted a proposal by M. Daix, to light the place de la Concorde with acetylene gas during the forthcoming Exhibition.

THE Geological Society has this year awarded its medals and funds as follows:—The Wollaston medal to Prof. G. K. Gilbert, of Washington; the Murchison medal to Baron A. E. Nordenskiöld, of Stockholm; the Lyell medal to Mr. J. E. Marr, of Cambridge; the Wollaston fund to Mr. G. T. Prior; the Murchison fund to Mr. A. Vaughan Jennings; the Lyell fund to Miss G. L. Elles; and the Barlow-Jameson fund to Mr. G. C. Crick and Prof. T. T. Groom.

THE annual congress and exhibition of the Sanitary Institute will be held at Nottingham about the end of August.

THE annual general meeting of the Institution of Mechanical Engineers will be held on Friday, January 26.

THE Royal Bavarian Academy of Sciences has conferred upon Herr Eugen Wolf, the explorer, its large gold medal for services rendered to science.

THE St. Petersburg correspondent of the *Times* announces that a special separate department has been created in the Russian Council of State, to be called the "Section of Industry, Science and Trade." Under the head of Science, it is intended that this new department shall help to direct the advance of national education, a subject which, in connection with the economical development of Russia, is now beginning to obtain the powerful support so much needed.

WE learn with regret from Prof. H. H. Giglioli that Mr. John Bernard Stallo, of Cincinnati, U.S.A., died at Florence on January 6, in his seventy-sixth year. Judge Stallo, as he was usually called, was well known as a philosopher, mathematician and physicist; he was, during President Cleveland's first term of office, Ambassador of the United States at Rome. Since then he had lived in Florence amidst his books, taking to the very last a keen interest in the progress of science. Prof. Mack's last book is dedicated to him.

WE learn from *Science* that Prof. E. B. Wilson, of Columbia University, has been elected president of the American Society of Naturalists, in succession to Prof. W. G. Farlow, of Harvard University; and Dr. William McMurtrie, of New York City, has been elected president of the American Chemical Society, in succession to Prof. Edward Morley.

SIR WILLIAM MACCORMAC is contributing to the *Lancet* some valuable notes on the treatment of the wounded at the seat of war, and the wounds produced by modern bullets. He is particularly well qualified to express an opinion on the severity of bullet-wounds, for he had excellent opportunities of observing the lesions resulting from bullets during the Franco-Prussian war, and he states that in most cases the damage done by the modern bullet, especially by the Mauser, cannot be compared in severity with that inflicted by the needle-gun or the Chassepôt. His articles put medical men in the possession of much information not hitherto available, and constitute a real contribution to scientific knowledge.

SEVERAL correspondents have sent descriptions of solar halos and parhelia observed from various parts of Sussex and Surrey on Thursday last, January 11, between 9.30 and 11.30 a.m. Judging from the particulars communicated to us, what was seen was a typical exhibition of this meteorological phenomenon, which is not unfrequent in these latitudes, though it is rarely so well defined as it was on Thursday. The halos consisted of (1) a first bow concentric with the sun, red within, blue or green without, and having an angular radius of 21° or 22°; (2) a second circle or halo, similar to the first, but at twice the angular distance from the sun; (3) two inverted arches touching the two concentric halos, blue or green on the concave side, and red on the convex; (4) bright patches or mock suns on the same level as the sun, and apparently lying on the halos. The sky, except near the horizon, was cloudless but misty, the sun being faintly visible. This is the usual condition for the formation of halos, which are produced by the reflection and refraction of the sun's rays by the minute ice-crystals which constitute cirro-stratus clouds. A writer from New Shoreham, Sussex, remarks that the mock suns are there called "sun hounds," and in Kent "sun dogs."

FROM a recent issue of the *Times* we learn of a brilliant daylight meteor which was seen by several observers on the afternoon of January 9. Mr. H. H. P. Bouverie, writing from Glynde Place, Lewes, remarks: "Whilst shooting here to-day I saw a brilliant meteor, which started from near the moon, that was

quite bright at the time; it travelled for a short distance towards he north-east, and left a marvellously luminous path of white ight. The time of its appearance was as near 2.55 p.m. as possible. I never heard of such a thing being seen in broad daylight." Another observer writes: "At 2.55, in brilliant sunlight, a remarkable meteor was seen by a party of five from Reigate Heath Golf Ground. The course of the meteor was south to north, and it traversed a considerable portion of the heavens. In appearance it resembled a kite with a tail of a luminous white colour. It was visible for about a second." From the Drive, Brighton, the Rev. R. Hudson writes with respect to the same meteor: "The colour was brilliant white, like an incandescent gas-light. There was a nucleus and tail of considerable length. The altitude was about half that of the moon, which was visible at the same time. The sky was cloudless and blue, and the sun was shining brightly. The general effect was that of the falling stick of a rocket, and, indeed, my first impression was that it was a peculiar daylight rocket, but a moment's consideration of the direction of flight convinced me that it was a very remarkable meteor."

THE *Scientific American* states that the American Museum of Natural History has acquired, through the generosity of President Jesup, the second half of the Cope collection of fishes, amphibians and reptiles brought from Kansas, Colorado, Wyoming, Montana and other sections of the West between the years 1867 and 1896. In 1895 the first part of this collection was presented to the Museum by the trustees, so that now the entire life work of the late Prof. Cope will be permanently represented there. The proceeds of the sale of the collection will form an endowment fund for a professorship of natural science in Philadelphia.

ALL the vertebrate collections of the late Prof. O. C. Marsh, belonging to the U.S. Government have been transferred from New Haven, Conn., to the U.S. National Museum at Washington. Such material as may be necessary will be used for study and illustration in the completion of the monographs that were in course of preparation by Prof. Marsh at the time of his death. The actual number of specimens represented in this collection cannot yet be stated. They range in size from minute teeth of fossil mammals to individual specimens weighing from 500 to 2000 pounds each. The collections are rich in large Dinosauria, especially in examples of *Triceratops* and *Stegosaurus*, while the series of Titanotherium skulls is one of the best, if not the best, in existence. It contains fifty or more complete examples cleaned, and a number in the rough, besides many hundreds of bones. Among the specimens transferred are the types of forty or more species, including Dinosaurs, and Jurassic, Cretaceous and Tertiary mammals. The value of the entire collection is estimated at over 150,000 dollars. Referring to the transference, Prof. S. P. Langley remarks that the addition of this immense collection of most important American fossil remains to the treasures already assembled in the National Museum will afford the greatest satisfaction to all workers in the field of palæontology both at home and abroad.

AN account of certain preliminary experiments conducted with the view of establishing communication by wireless telegraphy between Chamounix and the summit of Mont Blanc has been detailed before the French Physical Society by MM. Léon and Louis Lecarme, and is summarised in No. 140 of the *Bulletin* of the Society. The experiments were conducted last August. The chief difficulties from the point of view of the propagation of Hertzian waves were: (1) the difference of altitude of 3450 metres between the two stations, with a consequent considerable difference of potential between the two masts; (2) the influence of cloud layers more than 200 metres thick in bad weather, these clouds often consisting of snow in a dense state of condensation; (3) the intense electric phenomena which frequently occur at high altitudes; (4) the two earthed wires whose extremities in this case could not be regarded as at a common zero potential owing to the thick coating of ice and hard snow covering the upper part of the mountain, whose high resistance might cause a considerable difference of potential between the "earth" of the summit and of Chamounix. The transmitting apparatus at Chamounix consisted of a coil giving an 18 cm. spark and a Hertzian oscillator, the balls were 2 cm. apart for giving the best results. The manipulator sent the current from a dynamo of 50 volts through the primary of the coil, and an "antenna" 25 metres long concentrated the waves. The receiver, situated at the Vallot observatory 4350 metres in altitude, was 12 kilometres distant as the crow flies, and consisted of a Branly radioconductor. The experiments were carried on for six days, and gave satisfactory results, but the three-phase currents employed in the electric lighting installation at Chamounix entirely stopped all communication. MM. Lecarme, however, propose to make use of these currents in future experiments.

ATTENTION has already been called in these columns to the system of electrical and magnetic units advocated by Dr. Franz Kerntler in his paper "Die Unität des absoluten Maass Systems. . . ." (Budapest, 1899). An account of the Kerntler system is now given by Prof. Rinaldo Ferrini, who, writing in the *Rendiconti del R. Istituto Lombardo*, expresses himself as distinctly in its favour.

THE established system of electrical units has been subjected to analysis and criticism by Prof. J. A. Fleming, F.R.S., in recent issues of the *Electrician*, and the concluding article of the series appears in the current number. Prof. Fleming does not definitely advocate any particular system, but he gives the outlines of a scheme of units which merits consideration both from theoretical and practical points of view. In conclusion, he remarks: "Those who have experience in teaching will agree that a clear view of the fundamental facts and statements is essential if the student is to make any satisfactory progress in handling advanced problems and ideas. In the class-room, no less than in the workshop, every one concerned with electromagnetic phenomena needs exact conceptions and not confused ideas of first principles. Experience shows that our present system of unitation and our existing terminology in describing electric and magnetic effects are not well adapted to facilitate this clearness. We may then ask: Should not the entrance into the twentieth century be inaugurated by some attempt to organise, simplify, and render more symmetrical the language and symbols in which are described the phenomena of electricity and magnetism, with the object of making calculation more easy and thought more precise?"

THE Pilot chart of the North Atlantic Ocean, issued by the Hydrographic Office of Washington, for January contains, in addition to the usual useful information, a sub-chart showing the average tracks of 121 January storms over the North Atlantic during the ten-year period of 1889–98. The chart shows that the region of maximum storm frequency for that month lies to the north of the steamship routes, in a belt extending north-eastward from Nova Scotia and Newfoundland across the Atlantic. Some of these storms are the most severe, the largest in area and the longest in duration, and may be traced entirely across the ocean, while others disappear to the northward. The storms are divided into nine classes, according to the regions in which they first appeared.

THE Central Meteorological Observatory of Moncalieri has published Vol. II. of the *Annuario storico* for the year 1900 (398 pages). The work contains a large amount of useful information,

including articles and memoirs on various interesting subjects by Italian men of science, and notices of several prominent Italian meteorologists. The work also includes valuable bibliographical notices (1) of recent publications and of articles which have appeared in scientific periodicals both in Italy and other countries; and (2) references to the works of several deceased Italian meteorologists.

BRITISH agriculturists are slowly waking up to the advantages of scientific methods of dealing with diseases of crops. Dr. J. A. Voelcker, consulting chemist to the Royal Agricultural Society, reports in the *Journal* of the Society that the use of "blue vitriol" (sulphate of copper) for agricultural purposes has been considerably extended of late. It has long been employed, either alone or in different preparations of which it formed a constituent part, as a dressing for seed wheat. But of later years the spraying of the potato crop with "Bouillie Bordelaise" mixture, to guard against potato disease, has become more general; and quite lately a further employment of sulphate of copper has been brought to the front in the spraying of corn and other crops infested with charlock, a solution of this salt being used, apparently with good result, for the purpose. Dr. Voelcker has found that the sulphate of copper supplied to farmers is frequently adulterated with sulphate of iron. He points out that the two things do not serve the same purposes agriculturally; for, while sulphate of copper has undoubtedly great value for grain-dressing preparatory to sowing, potato spraying, and charlock destruction, sulphate of iron is practically useless.

TWO papers on the purification of waste in water from manufactories were read before the Institution of Civil Engineers on January 9. One of the authors, Mr. R. A. Tatton, gave a detailed description of the works at three manufactories where the trade waste is efficiently treated. In one of these, where the process of ordinary bleaching, dyeing and finishing is carried on, the works for purifying the trade waste consists of precipitation-tanks and filters, sludge-tanks, presses, &c. The volume of water at times amounts to 500,000 gallons per day; it is treated with lime and "iron alum" and settled in tanks in which most of the suspended solids are intercepted; from these tanks the water is pumped to a second series of tanks for further precipitation, and the clear liquor is finally passed through cinder filters to the stream. In the works of a large firm of woollen manufacturers, dyers and finishers, the trade waste is pumped into a series of three tanks, in which the solids are precipitated by lime and ferric chloride, the clear liquor passing forward through a second series of tanks and filters into the stream; the sludge is discharged on to filters composed of cocoanut matting, and after it has dried sufficiently, it is pressed and the oil extracted. The dye-water from the mill, to which is added the clear liquor from the grease tanks when they are being drawn off for cleaning, is settled in a series of tanks and filtered. The volume of water dealt with is 180,000 gallons per day. In another firm, carrying on the processes of calico printing, dyeing and bleaching, the pollution is caused by alizarine, logwood and other dyes, soap, starch, &c. The total volume of the trade waste amounts to about 70,000 gallons per day; the water from the various departments is collected to a well, whence it is pumped to the purification works, which consist of a central settling-tank and two precipitation-tanks used alternately; iron alum is used as precipitant. The sludge is drawn from the settling and precipitation-tanks into a well and is thence pumped to a sludge-drying area. The water from the precipitation-tanks is finally filtered through fine ashes.

THE mineral resources of Vancouver and adjacent islands, British Columbia, are dealt with by Mr. W. M. Brewer (*Trans.* Inst. Mining Eng., 1899). Gold, iron-ore (magnetite) and coal are chiefly referred to. The author considers that th possibilities of Vancouver Island as a mineral-producing region are very promising. The climate is temperate, and there are numerous deep-water harbours. There is, however, at present a lack of waggon-roads and good trails from the coast to the interior.

THE mineral wealth of Zoutpansberg forms the subject of an article by Mr. Douglas S.-S. Steuart (*Trans.* Inst. Mining Eng., 1899). The district of Zoutpansberg (Salt-pan Mountain) lies in the northern part of the Transvaal, and comprises about 25,000 square miles, of which proclaimed gold-fields cover 3500 square miles. The author now gives special attention to the gold-bearing reefs in the strata of the Murchison range; these extend seventy miles, and have an average width of four miles. The oldest rocks, known as the Letaba and Murchison range schists, are considered to be of pre-Cambrian age. The series has been tilted into an almost vertical position, and it includes various schists and quartzites, granites and gneisses, which are penetrated by dykes of basic igneous rock. Numerous richly auriferous veins occur among the schists. Auriferous banket, yielding 5 to 15 dwts. per ton, occurs at the base of the Drakensberg series—a group of sandstones, quartzites and conglomerates, which rest unconformably on the older rocks. The paper is illustrated by map, sections and pictorial views.

THE *Zeitschrift der Gesellschaft für Erkunde zu Berlin* contains a paper on the desert of Atacama, by L. Darapsky, with a new map of the region. The main features of the topography are described and illustrated by photographs, and some analyses of the waters of thermal springs and salt marshes are given.

IN the new number of *Spelunca*, M. E. A. Martel gives a summary of the results of recent observations on the movements of water under glacier ice. The paper consists for the most part of a correspondence between the author and Prof. Forel, especially concerning experiments in tracing the movements of underground waters by coloration with fluorescein.

BEGINNING with the number for the last week of November, *Die Natur* publishes a series of articles on the Antarctic regions and Antarctic voyages, translated from a paper by Axel Ohlen in *Ymer*, by A. Lorenzen. The detailed account given of the history of Antarctic discovery is of special interest at the present time.

PROF. W. M. DAVIS, of Harvard University, contributes a valuable note on "A Fault Cliff in the Lepini Mountains" to the December *Bollettino della Societa Geografica Italiana*, illustrated by a number of excellent photographs. The note is translated by Fr. M. Pasanisi, who adds some bibliographical paragraphs, and expresses the hope that the study of geomorphology may receive more attention from Italian geographers.

BESIDES the usual meteorological notes, the new number of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schutzgebieten* contains an interesting paper on the native methods of extracting and manufacturing iron in Togoland. Diagrams of different forms of furnace are given, and a vocabulary of technical terms in various dialects.

THE publication of the scientific results of the Norwegian North Polar expedition (1893-1896), edited by Dr. Nansen, will be commenced almost immediately by Messrs. Longmans, Green and Co. The whole work is estimated to form five six quarto volumes, which it is hoped will be completed in the course of about two years; it will be issued in the English language only.

AN Earthquake Investigation Committee was instituted by the Japanese Government in 1893, for the collection of facts relating to earthquakes in Japan. The work was at first superintended by the late Prof. S. Sekiya, and, since his death, in January 1895, has been carried on by Mr. M. Tayama. It is now approaching completion, and, in the meantime, Prof. Omori has issued a catalogue which will serve as an index to the future report of the Committee (*Journal* of the College of Science, Imperial University, Tokio, vol. xi. Part 4). This has been compiled from 427 different kinds of Japanese histories and chronicles, and gives the dates, districts and intensities of 1898 earthquakes between the years 416 and 1867. The catalogue is followed by a most valuable discussion of its contents by Prof. Omori, in which he considers the distribution of the earthquakes in time and space. The total number of destructive earthquakes is 220, but, as the early annals are incomplete, it seems likely that one part or other of Japan will be visited by a destructive earthquake once in about two-and-a-half years. While they sometimes happen singly, they tend to recur in groups during epochs of maximum frequency, which happen on an average once in every thirteen or fourteen years. If the shocks are counted during consecutive half-centuries, the destructive and the small shocks have their maxima and minima at nearly the same epochs. But when examined in detail this is not the case. For instance, destructive shocks are most numerous during the months of July and August, while the ordinary shocks are least frequent at about the same time. The explanation which Prof. Omori suggests for this reversal is that the constant recurrence of small earthquakes maintains the region concerned in a normal or safe condition, thereby preventing any abnormal accumulation of stress in the earth's crust. Again, dividing the destructive earthquakes into local and non-local, according as the damage caused by them was confined to one province or distributed over several, it appears that the provinces on the concave or Japan Sea side of the group of islands were disturbed almost wholly by local shocks, while those on the convex or Pacific side were often disturbed by great non-local ones, the origins of which were situated beneath the ocean, and sometimes caused fearful sea-waves.

MINUTE, neatly worked flint implements have recently been found in great numbers in East Lancashire and South Yorkshire. Mr. R. A. Gatty describes in *The Reliquary and Illustrated Archaeologist* (vol. vi., 1900, p. 15) how he has found many hundreds of these "Pigmy flint implements," as he terms them. Others have been found in various parts of England, but not so abundantly as in Yorkshire; but that may be owing to their having been overlooked. They appear to be always associated with rough Neolithic implements, but there was a total absence of polished implements. Mr. Gatty figures some of these interesting objects, and places side by side figures of "pigmy flints" from Indian caves and from the surface of the ground at Hoxton Roberts (Yorks.); the forms are apparently identical. Similar tools have been met with in France and Belgium.

TWO Neolithic graves in the neighbourhood of Worms are figured in *Die Umschau* (Tom. iii., p. 1023). In the man's grave were found stone implements and pottery, the latter is also figured; and in the woman's grave was a food-pounder.

HERR E. LEMMERMANN reprints, from the *Proceedings* of the Natural History Society of Bremen, an account of the Plankton algæ (including Peridinieæ) collected in Prof. Schauinsland's expedition to the Pacific in 1896–1897. The general features of the Plankton flora of the Pacific Ocean are discussed, and four new genera of Schizophyceæ are described—*Coelosphaeriopsis*, *Chondrocystis*, *Haliarachne*, and *Katagnymene*—as well as a number of new species and forms.

MR. M. A. CARLETON publishes, in the form of a report to the U.S. Department of Agriculture (Division of Vegetable Physiology and Pathology, *Bulletin* No. 16), an exhaustive paper on the Cereal Rusts of the United States. He finds six, or probably seven, distinct rusts affecting the cereal crops, of which by far the most destructive are the "black stem rusts" of wheat and oats, *Puccinia graminis Tritici* and *P. graminis Avenae*. The injury to the crops by these fungi is on an enormous scale. The report goes into details respecting the varieties of the cereals best able to resist the parasites, and the best means of warding off their attacks. It is illustrated by several very well executed coloured plates.

WITH the exception of two papers by Dr. O. Finsch on birds, the latest issue of the *Notes from the Leyden Museum* is devoted to invertebrates. Perhaps the most generally interesting contribution is one by Dr. J. G. de Man on the crabs collected by the Dutch Scientific Expedition to Central Borneo; the materials obtained showing, as in the case of the crayfish previously described, how extremely imperfect was our knowledge of the carcinological fauna of the country. Out of a total of fifteen species collected, of which all but one were land or fresh-water forms, no less than eleven or twelve proved to be new to science. And whereas only three fresh-water crabs were previously known to inhabit the island of Borneo, the number is now raised to fifteen. Very noticeable is the discovery of a crab belonging to the genus *Menippe*, closely allied to the rare *M. panope* from Tranquebar; since, with the possible exception of the last-named, all the species of that genus hitherto known, as well as those belonging to the allied *Myomenippe*, are marine forms.

MANY interesting and instructive articles on diverse scientific subjects are contained in the volume of *Knowledge* for 1899, a copy of which has been received. The fine collotype illustrations distributed through the volume form an attractive characteristic of this monthly magazine of science.

THE fourteenth volume of the new series of *The Geographical Journal*, containing the numbers from July to December 1899, has just been published. The papers, articles, monthly bibliography, and numerous maps, combine to make the volume, like preceding ones, a valuable record of the progress of the knowledge of the earth.

THE genus Cardium, of which the edible cockle is by far the commonest member, forms the second number of the memoirs of the Liverpool Marine Biology Committee, the author being Mr. J. Johnstone. A detailed account is given of the anatomy of the cockle as a typical Lamellibranchiate Mollusc, and the economic importance of the cockle, with special reference to the Lancashire Sea-Fisheries district, is described in an appendix. Seven plates illustrate the points dealt with in the memoir.

THE "Annuaire" of the Bureau des Longitudes, for 1900, has been received from Messrs. Gauthier-Villars, Paris. It is noteworthy that all the dates are expressed in Paris Mean Civil Time, commencing at midnight and reckoning from 0 to 24 hours, instead of dividing the day into two parts of twelve hours each as heretofore. As usual, the volume is filled with information of interest and value to all observers of the heavens, and also to other students of science, for the tables of constants contained in it cover a wide range of scientific work. The subjects of the special articles are machines for generating electric currents, by Prof. Cornu; the new gases in the atmosphere, by Prof. Lippmann; and work done at the Mont Blanc Observatory, by Dr. Janssen, who also writes on the application of aeronautics to the observation of certain astronomical phenomena.

THOUGH articles of scientific interest only occasionally appear in British monthly periodicals read by the general public, they are more frequent in the American magazines published here. The *Monthly Guide to Periodical Literature*, the first number of which has just been issued by the Advertising Agency of London, is therefore not without value from the scientific side; for it shows the titles and writers of articles in the chief magazines and reviews which reach us from the United States, and also in similar periodicals having their origin on this side of the Atlantic. Assuming that the editors of the various popular magazines know the pabulum best appreciated by their readers, an examination of the list of articles shows that science is given but scant attention by the reading public. A few editors with scientific knowledge as well as literary capacity might do much to increase interest in natural knowledge, and raise their readers' minds above the dead level of indifferent fiction and sensational science.

THE *Zeitschrift für physikalische Chemie* contains a very ingenious application by J. J. van Laar of thermodynamics to the results of Ramsay and Shields upon the association of liquids. Assuming that θ simple molecules of water are associated to form a compound molecule, Dr. van Laar applies the thermodynamical conditions of equilibrium to the rate of change of the constant of association with temperature, and applies the resulting formula to the experimental figures of Ramsay and Shields. The value of q, the heat of dissociation of the molecule $[H_2O]^\theta$ thus determined, should be constant if the right value of θ is assumed, and this is the case for water at temperatures between 0° C. and 60° C. if $\theta = 2$. The results are not so good if θ be taken as 3 or 4, and hence the author concludes that the association is correctly expressed by

$$(H_2O)_2 \rightleftarrows 2H_2O$$

with an absorption of 1930 calories per 18 grams of water. Ethyl alcohol also appears to be bimolecular, but for methyl alcohol and acetic acid $\theta = 3$ at least. The contraction ensuing when alcohol and water are mixed and the phenomenon of the maximum density of water are also considered from this point of view, with the striking result that the assumption of the partial association of liquid molecules explains, not only the contraction on mixing with alcohol, but also the irregular expansion of water.

THE additions to the Zoological Society's Gardens during the past week include a White-throated Capuchin (*Cebus hypoleucus*) from Central America, presented by Mrs. Vernon; a Blue and Yellow Macaw (*Ara ararauna*) from South America, presented by Mr. H. W. Stride; two Java Sparrows (*Padda oryzivora*) from Java, presented by Mr. Walter Buchanan; an Indian Dial-Bird (*Copsychus saularis*) from India, presented by Mr. W. H. St. Quintin; a Delalande's Gecko (*Tarentola delalandii*) from West Africa, presented by Mr. May; two Spotted Salamanders (*Salamandra maculosa*), European, presented by Mrs. Brett; a Hocheur Monkey (*Cercopithecus nictitans*) from West Africa, a Vulpine Phalanger (*Trichosaurus vulpecula*) from Australia, ten Nose-crested Iguanas (*Iguana tuberculata rhinolophus*) from Nicaragua, two Whooper Swans (*Cignus musicus*), European; a Starred Tortoise (*Testudo elegans*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

NEW MINOR PLANET (1899 E.Y.).—Herr Otto Knopf, of the Jena Observatory, gives the elements and ephemeris of this planet in *Astronomische Nachrichten*, Bd. 151, No. 3612, from which the following abridgment is obtained:—

Elements for Epoch 1900 *January* 0·0 *Berlin Mean Time.*

$$\left.\begin{array}{l} M = 345^\circ\ 32'\ 15''\cdot3 \\ \omega = \ 3\ 32\ 19\cdot9 \\ \Omega = 89\ 46\ 43\cdot3 \\ i = \ 15\ 22\ 20\cdot0 \\ \varphi = \ 5\ 13\ 16\cdot4 \end{array}\right\} 1900.$$

$$\mu = 651''\cdot293$$

$$\log a = 0\cdot490821$$

Ephemeris for 12*h. Berlin Mean Time.*

1899.		R.A.		Decl.
		h. m. s.		° ′
Jan. 18	...	4 9 34	...	+17 32·5
22	...	9 22	...	17 54·2
26	...	9 36	...	18 16·4
30	...	10 15	...	18 38·9
Feb. 3	...	11 19	...	19 1·9
7	...	4 12 46	...	+19 25·0

SCIENCE TEACHERS IN CONFERENCE.

THE Committee responsible for the arrangements in connection with the English Education Exhibition, which is now being held at the Imperial Institute, very wisely decided that a series of conferences, lectures and demonstration lessons arranged by the chief educational bodies throughout the country would form a valuable adjunct to their exhibition. The invitations which the Committee sent out met with a very cordial reception, and the programme of meetings for the discussion of educational questions includes nearly every grade and phase of English school life.

One of the most interesting of these events was a conference of science teachers from all parts of the country, arranged by the Technical Education Board of the London County Council. The success which attended similar gatherings during January 1899 convinced the promoters that nothing but good resulted from the discussion of methods of teaching different branches of science, and the meetings on January 10 and 11 were arranged in much the same way as those of the first conference last year. But whereas the subjects considered in 1899 were various branches of physics and chemistry, the greatest prominence was this year given to plans of instruction in natural history and manual training.

THE TEACHING OF BOTANY.

At the first meeting held on the morning of January 10 at the Imperial Institute, when the methods of teaching botany was the subject dealt with, the chair was taken by Sir John Lubbock. Papers were read by Prof. Miall, F.R.S., of the Yorkshire College, Leeds, and Miss von Wyss, of the North London Collegiate School for Girls.

Prof. Miall gave it as his opinion that the teaching of botany in schools is not spreading, though there is hardly any scientific inquiry which is at once so practicable and inviting. A special reason for encouraging the study of botany is that a knowledge of the great facts of plant-life is essential to scientific agriculture. Those who live by agriculture, which is still our greatest industry, are already beginning to demand that, in our rural schools at least, the scientific basis of agriculture shall somehow enter into the course of instruction. A school course may conveniently be divided into three stages according as the pupils are children (age 8–12), boys and girls (13–16), or young men and women (17–19). The science lessons given in the first stage should take the form of object lessons. In the second stage systematic science may be begun, and here chemistry and physics will be the common choice, but natural history should be kept alive by school natural history clubs and rambles. In the third stage, students who will follow some pursuit in which natural history plays a part, should take up natural history again and study it methodically in the light of their chemistry and physics.

In the first stage the following maxims were recommended by Prof. Miall. (1) No technical terms in Latin and Greek. (2) No lectures or information lessons. (3) No books in class. (4) Let all lessons be interrogations of actual objects, and largely of live plants. (5) Try to make the class active and

responsible throughout. Later, it was urged that everything that is taught at all in a school should come round pretty nearly every day for at least one year. In the third stage of teaching, when botany is studied for some special purpose, the great problems of the nutrition and reproduction of higher green plants should be specially studied. Such a course of plant physiology should occupy several hours a week for two or three years.

Miss von Wyss described how object lessons in botany might with advantage be given. She deprecated the idea that botany could be satisfactorily taught to young children apart from the study of zoology, and urged that such object lessons should be co-ordinated with the teaching of drawing and literature. The current idea that there is a difficulty in obtaining specimens in a large town was shown by the experiences Miss von Wyss related to be quite erroneous, and the success which object lessons have met with at the North London Collegiate School for Girls was dwelt upon.

Juvenile Research.

The afternoon meeting at the Imperial Institute was presided over by Sir Henry Roscoe. Prof. H. E. Armstrong, F.R.S., described in an interesting address the methods he had employed with his own children at home to educate them in the way of discovering for themselves the answer to questions which were presented in their ordinary life. The address was illustrated by practical demonstrations by Prof. Armstrong's little daughter and two young sons, and a series of lantern slides made it quite clear how the system described had been developed. In reading a book by the late Henry Drummond, called "The Monkey that would not Kill," the children cam e across the statement that a stone was lighter in sea-water than in air, and to satisfy themselves of the truth of the statement was the object of the piece of research which the children entered upon under the general supervision of their father. The steps in the inquiry were worked through again before a large audience, and the children themselves explained with remarkable intelligence what the object and result of each experiment were. Throughout the course of training, which was exemplified by the demonstration, each child kept a careful account of everything which was done, illustrating each step by means of sketches and recording every numerical result obtained. Prof. Armstrong maintained that the teaching of science to children was not commenced early enough, and that too little faith is shown by teachers in the reasoning faculties of young children.

Object Lessons.

The second day's meetings were held at the Shoreditch Technical Institute. Prof. Woods Hutchinson was to have given an address in the morning on "The Early Teaching of Natural History in Schools," but he was too ill to attend. Mr. J. W. Tutt read a paper on "Object Lessons in Natural History," in which he detailed the educational advantages of this method of instruction, the mode of giving a good object lesson, and a suitable scheme of lessons for young children. A discussion, in which a large number of teachers took part, followed. But, from one cause and another, the subject in hand received very little attention, and few actual working methods were explained.

Manual Work in Metal.

The concluding meeting was presided over by Sir J. F. D. Donnelly, and was concerned with the discussion of "Metal Work as a Form of Manual Instruction in Schools." Papers were read by Prof. W. Ripper, of University College, Sheffield, and Mr. Bevis, Director of Manual Instruction for the Birmingham School Board. Prof. Ripper's paper was concerned with the general considerations which make a development of the subject of manual instruction in metal desirable. It was pointed out that there has been a decided advance in this direction in recent years, and it was stated by Prof. Ripper that the exhibition of metal work in the Education Exhibition at the Imperial Institute is better than that of the recent Chicago Exhibition. Mr. Bevis gave an account of the course of instruction in metal work which was given to boys of Standards V. and VI., who were between the ages of ten and thirteen years, in the schools of the Birmingham School Board.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Mr. A. H. Evans, M.A., of Clare College, who is favourably known as one of the authors of the "Cambridge Natural History," was, on January 10, elected an Esquire Bedell in succession to the late Mr. Gill.

The Special Board for Biology propose that legal powers shall be obtained to vary the conditions of the Gedge Bequest for the furtherance of physiological research, so as to equalise the conditions on which "advanced students" compete with ordinary students for the prize under this foundation.

In his dedication of the fourth volume of "The Linacre Reports" to the Vice-Chancellor of Oxford University, Prof. R. Lankester avails himself of the opportunity to make some remarks upon the want of encouragement given by Oxford Colleges to work of the kind contained in the volume. The position of science at Oxford has already been dealt with in detail in these columns (vol. liv. 1896). The present method of apportioning the College endowments is most unsatisfactory, and Prof. Lankester's suggestion that two-thirds of such endowments should be given for the encouragement of the study of the natural sciences, and one-third for the subjects comprised under the general terms Literæ Humaniores and Modern History, is a more reasonable distribution. In any case, Oxford is not likely to become a University for students of science while a past professor is justified in making a statement such as the following concerning the distribution of endowments:—"It is, I know, useless to urge this, which is the judgment and practice of almost every University excepting our own, upon the consideration of those who now have the control of that splendid potential source of energy, the College endowments. They have, unfortunately, with rare exceptions, been brought up in complete ignorance of the scope and significance of the studies which they refuse to recognise; they deliberately and conscientiously use the advantage of their position so as to maintain the present one-sided system, and to discourage the study of the natural sciences by those who come as students to Oxford."

It is not only at Oxford that study and research in the domain of the natural sciences receive little encouragement. In the preface to the volume of "Studies in Biology from the Biological Departments of the Owens College," Profs. S. J. Hickson and F. E. Weiss refer to the fact that no more Bishop Berkeley Research fellowships will be available for original work. The remark "Biology is now left in our College without any fellowship or scholarship to enable a promising student to devote a year of his life to original investigation before commencing his career as a teacher or medical student, and our well-equipped research laboratory has consequently to remain unoccupied during the greater part of the year. We cannot help feeling that if these facts were more generally known some help might be forthcoming from those who realise what biology has done and is doing for the development of rational methods of modern medical research." Why the Bishop Berkeley fellowships, which once promised to rank among the best characteristics of Owens College institutions, are not now available is not explained.

At a general meeting of Convocation of London University held on Monday, the report of the standing committee was presented. The report dealt with the election by Convocation of members of the Senate under the new statutes. It stated that the representatives allotted to Convocation will have to be chosen in May. The representatives of Convocation will consist of the Chancellor (elected for life), the chairman of Convocation, and sixteen members, of whom eight will retire every two years. These eighteen will form a majority of the members of the Council for external students, who will have to advise the Senate regarding the whole of the present work of the University. The Academic Council, elected mostly by teachers of the University, will perform a like function for internal students. There is no restriction on the choice of candidates. The new constitution will probably be in the hands of the University before the next meeting of Convocation in May, and by that time the University will probably have taken up its abode in its new home at the Imperial Institute. After a short discussion, the report was adopted.

SCIENTIFIC SERIAL.

THE latest issue of the Memoirs (*Trudy*) of the Society of Naturalists at the St. Petersburg University, Section of Geology and Mineralogy (vol. xxvii., fasc. 5, 1899), will be found most interesting for mineralogists and petrologists—the more so as each paper, in Russian, is followed by a full, detailed summing up in German. The volume is edited by K. von Vogdt, and contains three important papers. The first, by M. Boris Popoff, is upon the elipsoidal inclusions contained in that most interesting granite, the Rappa-kivi ("rotten stone") of East Finland. It is an excellent, very well-written analysis of the different porphyr-like inclusions which are found in the granite—some of them surrounded by an oligoclase-envelopment and with defined outlines, while the others are devoid of that envelope, and in this case have an undefined or a wave-like surface. To explain the appearance of the different sorts of inclusions being mixed together in this granite, the author resorts to the hypothesis of a slow motion of the crystallised ovoids, formed in different parts of the mass, but consequently moving about within it during the cooling of the mass. The second paper is a note on a variolite found on the left bank of the Lower Yenisei. The third paper is a detailed work (353 pp. in Russian, and 37 pp. of German *résumé*), by B. Polenov, on the massive rocks of the northern parts of the Vitim plateau of East Siberia. The author has most carefully worked out the beautiful collection of samples of rocks which was brought in, in 1865, by the mining engineer, I. A. Lopatin. A most elaborate descriptive catalogue of this collection has already been published a couple of years ago by B. Polenov. Now he gives a summary of the geological conclusions which may be drawn out of this collection. He begins his work by a most valuable sketch of the geological structure of the plateau, based on Lopatin's, Kropotkin's and Tchersky's explorations; this sketch (28 pp.), unfortunately, is not summed up at all in German. The remainder of B. Polenov's work (325 pp.) is given to a careful discussion of the various rocks entering into the composition of the plateau—namely, the oldest granites with their subordinate syenites and gabbro-norites; the younger group of plagioclase rocks—syenites, diorites, and diabase rocks; and the youngest group of basalts which cover the plateau on immense stretches; and, finally, the metamorphism phenomena which have been going on in all these rocks. A number of plates accompany the papers.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1899.—"Vapour-density of Bromine at High Temperatures." By E. P. Perman, D.Sc., and G. A. S. Atkinson, B.Sc. Communicated by Prof. Ramsay, F.R.S.

The authors have determined the vapour-density of bromine at temperatures ranging from 600° to 1050° by a modification of the Dumas method, from which it differs in the following particulars:—

(1) The globe was filled with bromine by repeated exhaustion and admission of bromine vapour.

(2) The bromine was drawn off by repeated exhaustion and admission of air, collected in a solution of potassium iodide, and estimated by titration with sodium thiosulphate solution.

(3) The globe remained in position (in a muffle furnace) the whole time.

Temperature was determined by means of a Le Chatelier pyrometer. The chief results are as follow:—

Temperature.	Pressure.	Mean Vapour-density.
About 650°	Atmospheric.	80·0
830°	,,	79·7
900°	,,	78·6
950°	,,	77·5
1015°	,,	76·7
1050°	,,	74·3
1040°	755 mm.	76·0
,,	319	73·9
,,	189	73·3
,,	47	71·8

By plotting the results at atmospheric pressure on a curve, it is seen that dissociation begins at about 750° C.

These results are in accordance (as far as they can be compared) with those of V. Meyer and Crafts, but in opposition to those of J. J. Thomson, who found dissociation to take place at about 100° C. on continued heating.

December 14, 1899.—"Observations on the Morphology of the Blastomycetes found in Carcinomata." By Keith W. Monsarrat, M.B., F.R.C.S.E.

The research was undertaken to confirm, if possible, the observations of Sanfelice, Roncali and others on the presence of organisms of the order Blastomycetes in Carcinomata, and to study the morphology of the same.

The observations may be arranged under four headings:—(1) Isolation by Culture. (2) Staining Reactions. (3) Histology. (4) Tissue Reactions following Inoculation.

I. Isolation. Out of a large number of Carcinomata examined a positive result has up to the present been obtained only in the case of one Carcinoma of the breast. In this case a growth was obtained on glucose agar of an organism, the morphological characters of which are described below. The method of making inoculations on to media was by making numerous incisions into the growth with a sterile knife and inseminating the scrapings from the edges of these. The organisms grow readily both ærobically and anærobically at 37° C.

II. Staining Reactions. In the lesions produced by inoculation of the organism, the staining reactions were studied by a variety of methods, of which a modification of the method of Cladius for bacteria gave the most distinctive results, after fixation in Flemming's solution. By using this method for human Carcinomata both extra- and intracellular forms of cancer-bodies are distinctively stained.

III. The morphological characters of the organism are as follows: Fresh specimens from cultures are spherical, from four to ten micros in diameter, and in most cases take an aniline chromatin stain diffusely. From this type there are all variations up to that in which no chromatin at all is to be observed. There is a capsule varying in density; multiplication takes place by budding. In certain cases, however, spore formation takes place. This was observed only in secondary nodules in certain organs, which followed growths in the peritoneum produced by inoculation. It consists in a thickening of the capsule, the breaking up of the chromatin of the cell into discrete particles, and the escape of the latter through a dehiscence in the capsule. There is no regularity in this process, no simultaneous division of the cell contents into a definite number of spores, and no simultaneous shedding of the same, as in the case of members of the Blastomyces Group.

IV. Tissue Reactions. Intraperitoneal injection in guinea-pigs has alone been used so far. One c.c. of a 48-hours old culture was injected in each case. Stated briefly, the results consisted in a production of "tumours" of endothelial elements in the peritoneum, and secondary nodules in lungs, liver, spleen and kidneys of a similar type. When brought in contact with endothelium, the organism is capable of stimulating proliferation and causing the production of new growths locally and in organs distant from the seat of inoculation.

Geological Society, December 20, 1899.—W. Whitaker, F.R.S., President, in the chair.—Dr. P. L. Sclater exhibited a large diagram of a new bore lately made for the Zoological Society of London, in the bottom of the old well in the Society's Gardens, Regent's Park. The section was a valuable addition to the literature of the water-supply from wells in the surrounding district.—On some effects of earth-movement on the Carboniferous volcanic rocks of the Isle of Man, by G. W. Lamplugh (communicated by permission of the Director-General of the Geological Survey). The author, since the completion of his survey of the Isle of Man, has studied the coast-section in the Carboniferous volcanic series between Castleton Bay and Poolvash, with the result that he has discovered evidence that the strata have undergone much deformation in pre-Triassic times. In the western part of the outcrop the volcanic material consists almost wholly of tuff, in places bedded and fossiliferous; in the eastern part exists a chaotic mass of coarse and fine fragmental volcanic material, traversed by ridges of basaltic rock, and containing entangled patches of dark limestone. The author now considers that the larger lenticles and most of the smaller blocks of limestone have been torn up from the underlying limestone-floor during a sliding forward or overthrusting of the volcanic series upon it. The phenomena

described may be explained as the effects of earth-movement on a group of rocks consisting of limestone passing up into tuff, interbedded with lava-flows, and possibly traversed by sills or dykes of basaltic rock. The results of the disturbance appear to be limited vertically and horizontally, and to have been determined by the differential resistance of the component rocks. Analogous features occur in the Borrowdale volcanic series and in the Silurian volcanic rocks of Portraine. The President, after congratulating the author on his paper, read the following extract from a letter that he had received from Sir Archibald Geikie, who was unable to be present :—"Having been twice with Mr. Lamplugh over the ground which he describes, the second time quite recently, since his present views as to earth-movement were formed and matured, I am glad to bear my testimony to the exhaustive care which he has expended on the research. I agree with him on the main point—that there is conclusive evidence of considerable earth-movement since the deposition of the Carboniferous volcanic rocks at the southern end of the Isle of Man. He seems to me to have established this point beyond dispute."—The zonal classification of the Wenlock shales of the Welsh borderland, by Miss Gertrude L. Elles. This paper deals with the Wenlock rocks of Builth, the Long Mountain, and the Dee Valley. The results obtained by the author completely confirm the work of Tullberg on the Wenlock shales of Southern Sweden. In the discussion which followed, Prof. C. Lapworth pointed out the extreme interest of this paper, both from the stratigraphical and from the palæontological point of view. The zonal mapping of the Welsh Silurians commenced by Prof. Watts, carried through the Rhayader Valentian by Mr. Herbert Lapworth, had here been brought out in detail stage by stage through the Wenlocks of the Welsh border by the author.—On an intrusion of diabase into Permo-Carboniferous rocks at Frederick Henry Bay (Tasmania), by T. Stephens. The relationship of the abundant diabase to the Permo-Carboniferous strata of the island has been long a matter of dispute. Among others, Jukes describes sections which appeared to confirm the view that Permo-Carboniferous sediments were deposited round vast masses of igneous rock previously cooled and denuded. The author has identified and visited the sections, and finds in one that, although there is a step-like junction between the sediments and the igneous rock, it is the result of the intrusion of diabase, and not of the deposition of sediment. The sediment, which is fossiliferous, is converted into an intensely hard whitish marble, and the associated shale-bands into chert. The diabase, which is ordinarily an ophitic rock, acquires at the junction a finely crystalline-granular texture. Jukes's second section also gives undoubted evidence of intrusion.

Mathematical Society, January 11.—Lieut.-Colonel Cunningham, R.E., Vice-President, in the chair.—Prof. Love, F.R.S., communicated a paper, by Mr. J. H. Michell, on elementary distributions of plane stress.—Lieut.-Colonel Cunningham (Mr. Kempe, F.R.S., *pro tem.* in the chair) gave a preliminary sketch of a general method of factorisation of biquadratics, with special application to quartans, $N=x^4+y^4$.—The following abstract of a paper by Prof. H. Lamb, F.R.S., entitled "A Problem in Resonance, illustrative of the Mechanical Theory of Selective Absorption of Light," was read by Mr. Tucker.—The impact of sound-waves on a fixed spherical obstacle was discussed by Lord Rayleigh in a well-known paper (*Proc.* Lond. Math. Soc., vol. iv. p. 253, 1872), which also treats briefly the case where the sphere is movable, but is urged towards a fixed position by a force varying as the displacement (*l.c.* p. 272). In the present paper this latter problem is studied under a more general form, it being supposed that the sphere is capable of various independent modes of free vibration; and special attention is directed to the case where there is coincidence, or approximate coincidence, between the period of the incident waves and that of one of the free modes. The immediate acoustical importance of the question is perhaps not very great, since massive bodies are not usually set into vigorous sympathetic vibration by the direct impact of air-waves (the extreme precision of tuning that would be required militates against this), but rather through the intermediary of resonance-boxes and sounding boards. The problem has, however, an interest in another direction, as furnishing an analogy by which we can illustrate, without any great expenditure of analysis, the mechanical theory of selective absorption of light in a gas.—A paper by Dr. L. E. Dickson, an abstract simple group of order 25920, was also communicated.

MANCHESTER.

Literary and Philosophical Society, January 9.—Prof. Osborne Reynolds, F.R.S., Vice-President, in the chair. Mr. Thomas Thorp exhibited two film-gratings of a ruling designed to weaken the image and to condense the illumination in the spectra of the first and second order, and thus to compete with the prism spectrum in brilliancy.—Geometrical representation of the relation between wave-velocity and group-velocity, by Prof. Horace Lamb, F.R.S. In any medium where the wave-velocity varies with the wave-length, a simple geometrical representation of the *group-velocity* is obtained by constructing a curve with the former magnitude as ordinate and the latter as abscissa. The group-velocity is then given by the length intercepted by the tangent to the curve on the axis of y. Thus, for gravity waves on deep water the curve is a parabola, and it appears at once that the group-velocity is one-half the wave-velocity, as is well known. Various other cases are illustrated in like manner; in particular, the case when the waves are of such moderate length that both gravity and surface-tension have to be taken into account. The existence of a minimum group-velocity, equal to 1.211 times the minimum wave-velocity, is pointed out.

EDINBURGH.

Royal Society, January 8.—Sir William Turner in the chair.—Dr. W. Craig Maclagan read a paper on two historical fallacies: Heather Beer and Uisge Beithe. After discussing the various literary references and oral traditions concerning heather beer, the author proceeded to describe his own attempts to brew the so-called ale according to several detailed recipes. In this he had the valuable assistance of Mr. Melvin, of the Boroughloch Brewery, Edinburgh. All attempts to obtain from heather a decoction capable of alcoholic fermentation failed absolutely. The tradition seems to have had its source in the idea that there must be sugar in the heather flower since bees visit it; but analysis proves that there is no real sugar present, but that there is beeswax. A similar investigation proved that the uisge beithe or birch ale had as fabulous an origin as heather beer.—Sir John Murray communicated a paper by Mr. R. E. Peake and himself on the Azores bank, and some recent deep-sea soundings in the North Atlantic. From Mr. Peake's soundings around the Azores, the configuration of the bottom could now be shown in great detail. In depths less than 2000 fathoms the bottom was found to be very irregular, the bank falling in some places from a depth of 1400 to 2400 fathoms within a distance of five miles. Four new "deeps" or depths exceeding 3000 fathoms had been discovered—the Peake Deep between the Azores and the English Channel, and the Libbey, Sigsbee and Thoulet Deeps to the south of the "tail" of the banks of Newfoundland. Some remarkable differences in bottom temperature had been observed; for example, the temperatures taken on the southerly of two lines between the Azores and North America were about half a degree lower than those taken on the northerly line; and the temperatures along the northerly of two lines between the Azores and the British Isles were about three-quarters of a degree lower than the others.—Dr. W. Peddie and Mr. A. B. Shand, in a paper on the thermoelectric properties of solid and liquid mercury, described how by the use of solid carbonic acid they had traced the thermoelectric line of mercury well below its freezing-point. The line seemed to be a fairly continuous straight line down to the lowest temperature reached; it lay nearly parallel to the iron line, converging slightly so as to pass through a neutral point about $-550°$ C. It cut the line of $0°$ C. a little below the copper line.—A paper was also read on an optical method of determining the density of sea-water, by Mr. John J. Manley. The apparatus used was the hollow quartz prism and spectrometer belonging to the Royal Society of London. Into this the various samples of sea-water were put in succession, and the deviations of the D line compared with the deviation due to distilled water. All precautions were taken, and the method was found to have several advantages as regards rapidity and convenience over the usual methods of comparing densities of sea-water.

Mathematical Society, December 12, 1899.—Mr. R. F. Muirhead, President, in the chair.—Dr. Peddie gave an address on the dissipation of energy in vibrating matter, with lime-light illustrations.—It was agreed that Professor Gibson's paper on Proportion be printed in the Society's *Proceedings*.

PARIS.

Academy of Sciences, January 2.—M. Maurice Lévy in the chair.—M. Ph. van Tieghem, the retiring President, announced to the Academy the changes that have occurred amongst the members and correspondents during 1899.—M. Maurice Lévy delivered a short address on taking the presidential chair.—On the anomaly in the movement of the fifth satellite of Jupiter, by M. O. Callandreau. This deviation, to interpret which M. Asaph Hall has suggested a modification of the Newtonian law of attraction, may perhaps be explained in a less drastic manner by admitting that for such bodies as the sun and Jupiter, at the surface of which observation has shown fluids in relative movement in the neighbourhood of the equator, the resultant of the forces, instead of being rigorously normal to the surface at each point, tends, near the equator, to bring the molecules of this plane nearer together.—On the plastic activity of animal cells, by M. L. Ranvier. Some serous secretion from the peritoneum of the rat, containing some air bubbles, was heated in a moist chamber at 30° to 36°. It was observed that the lymphatic cells moved towards the bubbles, and, on arriving at their surface, were flattened there as against a resisting body. If the whole is cooled down to 21°, the cells become again spherical. The name of plastic activity is given to this phenomenon, which is a vital one. The flattening of the lymphatic cells against resisting bodies had been noted previously by the author; but it had not appeared to be possible that this effect could be produced by an air bubble.—On the culture of white lupins, by MM. P. P. Dehérain and C. Demoussy. As the result of three years' cultures, it was found that the white lupin does not attain its full development when there are no nodules on the roots. These nodules, when present, may differ greatly in size and appearance, the maximum assimilation of nitrogen corresponding with the smallest nodules.—The Perpetual Secretary announced the deaths of Sir James Paget, Correspondant for the Section of Medicine and Surgery, and of M. Matheron, Correspondant for the Section of Mineralogy.—The lunar eclipse of December 16, 1899, at the Observatory of Lyons, by M. Ch. André. The occultations of several stars were observed under excellent conditions.—Observations of the sun made at the Observatory of Lyons with the Brunner 16 cm. equatorial during the third quarter of 1899, by M. J. Guillaume. The results are expressed in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On orthogonal systems, by M. Servant.—On the elementary law of electromagnetism, by M. Raveau. In the determination of the action of an indefinite current upon a magnetised needle, MM. Biot and Savart made the assumption that the effect of the wires from the battery could, owing to their distance, be safely neglected. According to the author this is not the case.—On the manganic oxidation of citric and malic acids, by M. G. Denigès. By the direct oxidation of citric acid with potassium permanganate, a good yield of acetone-dicarboxylic acid is produced, easily separable by mercuric sulphate in the form of an insoluble mercury compound. Malic acid, similarly oxidised, but treated with mercuric acetate instead of the sulphate, gives oxalacetic acid. The author suggests that these reactions may be advantageously utilised in analysis.—On acidimetry, by MM. Henri Imbert and A. Astruc. A study of the acidimetry of weak acids, including phenols, fatty and aromatic acids, halogen and nitro-derivatives of the acids, polyphenolic and amine acids, with the three indicators helianthine A, phenolphthalein, and Porrier's blue.—On some amines containing the camphor ring, by M. G. Blanc. The reduction of isolauronolic nitrile was attempted in the hope of producing β-aminocampholene, the amide of β-campholenic acid. The reduction proved to go further than this, a saturated base $C_9H_{15}.CH_2.NH_2$ being produced, of which the chlorhydrate, nitrate, chloroaurate, sulphate, oxalate, picrate, benzoyl derivative, and corresponding urea are described. The reaction of the base with ethyl iodide was also studied.—On the allotropy of benzophenone, by M. Œchsner de Coninck. It is shown that among the conditions governing the transformation of the stable modification of benzophenone into the unstable form, the phenomenon of slow oxidation is one of the most important.—The green pigment of *Amanita muscaria*, by M. A. B. Griffiths.—On the soluble ferments produced during germination of seeds with horny albumen, by MM. Em. Bourquelot and H. Hérissy. The seeds of *Trigonella Frenum graecum* and of *Medicago sativa* behave in a similar manner to the Carob bean during germination, secreting soluble ferments capable of hydrolising and rendering assimilable the reserve carbohydrates. The action of these ferments is comparable with that of warm dilute sulphuric acid.—The variations of plankton at Lake Chauvet, by M. Bruyant.—On the constitution of the ovarian follicle of reptiles, by Mlle. Marie Loyez. The follicle of reptiles is composed of two kinds of cells; small ordinary follicular cells, and large cells like young ovules, which may be considered as true abortive ovules, and the function of which is probably to assist in the formation of the vitellus.—Experiments on the freezing of ciders, by M. Descours-Desacres. A study of the fractional freezing of cider and perry.—Researches on beer, by M. Van Laer. It frequently happens that specimens of beer, which are clear and brilliant by transmitted light, appear to be turbid when examined by reflection. This disease, which is technically known as *double face* or *tweeskinde*, is due to contamination with a bacillus, named by the author *Bacillus viscosus bruxellensis*. A detailed account of the methods of isolation and cultivation of this bacillus is given.—On the plagioliparites of Cape Marsa (Algeria), by MM. L. Duparc and F. Pearce.

January 8.—M. Maurice Lévy in the chair.—Remarks on an earthquake in the province of Rhenish Hesse on December 20, 1899, by the French Consul at Frankfort-on-Maine.—Observations of the diameter and flattening of Jupiter, by M. G. Bigourdan. Since the calculated and found values for the motion of the fifth satellite of Jupiter are not in agreement, it appeared to be advisable to redetermine the magnitudes of the planet's diameter and flattening, since both these enter into the calculations. The mean equatorial diameter was found to be 38″·55, the mean polar diameter 36″·09, giving a flattening of 1/15·7.—Observation of the partial eclipse of the moon of December 16, 1899, made at the Observatory of Besançon, by M. P. Chafardet. The observations were interrupted by clouds at the commencement of the eclipse, but the occultations of six stars were measured.—On the absolute value of the magnetic elements on January 1, 1900, by M. Th. Moureaux.—On the theory of errors, by M. Estienne.—On the value of the internal pressure in the equations of Van der Waals and Clausius, by M. Daniel Berthelot. The author plots the curve $\omega v = f(\omega)$ (where ω is the reduced critical pressure and v the reduced critical volume), and compares the experimental critical isotherm for carbon dioxide (Amagat) with the theoretical critical isotherms deduced from the formulæ of Van der Waals and Clausius, and shows that while neither coincides with the experimental curve along its whole length, the Van der Waals formula gives a good approximation for pressures above the critical pressure, deviating considerably at lower pressures; while the Clausius expression is just the opposite. By empirically modifying the internal pressure term, an expression can be obtained which fits the experimental curve closely, and still contains only three constants.—Action of the magnetic field upon the Becquerel rays, by M. P. Curie. The author confirms the results previously obtained by M. Becquerel, that the rays emitted by polonium are not deviated by the magnetic field, and hence concludes that the preparation of polonium used by M. Giesel must differ essentially from that of the discoverer. Of the rays given off by radium, those deviated by the magnet form only a small part of the total radiation. The rays which suffer the most deviation in the magnetic field are those possessing the greatest penetrating power.—On the penetration of those Becquerel rays which are not deviable in the magnetic field, by Mme. Sklodowska-Curie. There appears to be a fundamental difference between those radiations from radium which are deviated in the magnetic field and those which are not. For the former, the coefficient of absorption decreases, or perhaps remains constant, when the thickness of the material which they are traversing remains constant, while the non-deviable rays, on the contrary, are more easily absorbed the greater the thickness of the material they have passed through. This singular law of absorption is different from that of any other known radiation.—On the nature of white light, by M. E. Carvallo. The author criticises the current hypothesis that white light consists of an undulation of the form $\varepsilon^{-kt} \sin ht$, and shows that it leads to a maximum of intensity at a wave length not corresponding with the maxima found by Mouton and Langley. If white light is due to a damped vibration $\varepsilon^{-kt} \sin ht$, the spectrum given by a grating should not be coloured, but consist of white light only.—Apparatus for instantaneous photography producing the maximum effect, by M. Guido Sigriste. The modifications embodied

in the apparatus described consist of a means of regulating the width of the slit of the shutter, keeping the edges absolutely parallel, and of moving the plane of the shutter a small determinate distance (0·1 mm.) from the focal planes. The times of exposure can be varied from 1/40 to 1/5000 of a second; the photographs with this instrument are very free from fog, and give the true light-values to the objects.—Application of the phase rule to alloys and to rocks, by M. H. Le Chatelier.—On the rhodio-cyanides, by M. E. Leidié. A detailed account is given of the best method of preparing the double cyanide of rhodium and potassium, which has the constitution $K_6Rh_2(CN)_{12}$. The crystals are isomorphous with the ferricyanide, cobalticyanide, manganicyanide, and chromicyanide of potassium.—New microchemical reactions of copper, by M. Pozzi-Escot. Ammonium iodide is added to the ammoniacal solution of copper salt; characteristic brownish-black rhomboidal tables are deposited.—On the presence of vanadium, molybdenum and chromium in plants, by M. Eug. Demarcay.—Mechanism of insufficient development in the offspring of diseased mothers, by MM. Charrin, Guillemonat and Levaditi.—On the andesites and basaltites of Cape Marsa, by MM. L. Duparc and F. Pearce.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—Upon the Development of the Enamel in certain Osseous Fish: C. S. Tomes, F.R.S.—Further Observations on "Nitragin" and on the Nature and Functions of the Nodules of Leguminous Plants: Miss M. Dawson.—On the Innervation of Antagonistic Muscles, Sixth Note: Prof. Sherrington, F.R.S.—On the Viscosity of Argon as affected by Temperature: Lord Rayleigh, F.R.S.—On the Behaviour of the Becquerel and Röntgen Rays in a Magnetic Field: Hon. R. J. Strutt.—On an Experimental Investigation of the Thermo-dynamical Properties of Superheated Steam by Prof. Osborne Reynolds' Method: J. H. Grindley.

ROYAL INSTITUTION, at 3.—The Senses of Primitive Man: Dr. W. H. R. Rivers.

SOCIETY OF ARTS (Indian Section), at 4.30.—Our Work in India in the Nineteenth Century: Sir William Lee-Warner, K.C.S.I.

LINNEAN SOCIETY, at 8.—On the Existence of Nasal Secretory Sacs and of a Nasopharyngeal Communication in the Teleostei: H. M. Kyle.—On the Origin of the Basidiomycetes: George Massee.

CHEMICAL SOCIETY, at 8.—Nitrogen Halogen Compounds: Julius Steiglitz and E. E. Slosson.—Chlorine Derivatives of Pyridine. Part V. Synthesis of $\alpha\alpha'$-Dichlorpyridine and Constitution of Citrazinic Acid: W. J. Sell and F. W. Dootson.—Action of Fuming Nitric Acid on α-Dibromocamphor: Dr. A. Lapworth and E. M. Chapman.—Electrolysis of Nitrogen Hydrides and of Hydroxylamine: Dr. E. C. Szarvasy.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 9.—Flight: Lord Rayleigh.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Utility of the Bacteriological Examination of the Throats of School Children during an Epidemic of Diphtheria: K. W. Goadby.—Advantages of Bacteriological Diagnosis as instanced by the History of an Outbreak of Diphtheria in a Large School: F. H. Berry.

MONDAY, JANUARY 22.

SOCIETY OF ARTS, at 8.—The Nature and Yield of Metalliferous Deposits: Bennett H. Brough.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—An Expedition to the Summit of Mount Kenya, British East Africa: H. J. Mackinder.

TUESDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—Structure and Classification of Fishes: Prof. E. Ray Lankester.

ZOOLOGICAL SOCIETY, at 8.30.—Note on some Remains of *Grypotherium* (*Neomylodon*) *listai* and Associated Mammals, from a Cavern near Consoelo Cove, Last Hope Inlet, Patagonia: A. Smith-Woodward.—On a Collection of Insects and Arachnids made in 1895 and 1897 in Somaliland, with Descriptions of New Species: C. V. A. Peel and others.—On the Mammals obtained in Southern Abyssinia by Lord Lovat during an Expedition from Berbera to the Blue Nile: W. E. de Winton.

MINERALOGICAL SOCIETY, at 8.—Mineralogical Notes: Prof. Miers.—On the Constitution of the Mineral Arsenates and Phosphates. Part IV. Beudantite: Mr Hartley.—Petrographical Notes on some Rock-Specimens from the Little Island of Trinidad, South Atlantic: Mr Prior.—A New Method of Deriving the Thirty-two Classes of Crystal Symmetry: Mr. Barlow.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Swing-Bridges over the River Weaver at Northwich: J. A. Saner.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Note on Dr. Vogel's Method of Preparing Subhaloid Salts of Silver: Major-General J. Waterhouse.

WEDNESDAY, JANUARY 24.

SOCIETY OF ARTS, at 8.—Local Government and its relation to Parish Water Supply and Sewerage: W. O. E. Meade-King.

GEOLOGICAL SOCIETY, at 8.—Contributions to the Geology of British East Africa. Part II. The Geology of Mount Kenya; Part III. The Elæolite-Syenite and Fourchites intrusive in the Coast Series: Dr. J. W. Gregory.—Fossils in the University Museum, Oxford. II. On Two New Species and Genera of Crinoidea; III. A New Species of *Oldhamia*, a Worm-track from the Slates of Bray Head, Ireland: Prof. W. J. Sollas, F.R.S.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Mathematical Contributions to the Theory of Evolution—On the Law of Reversion: Prof. K. Pearson, F.R.S.—On the Mechanism of Gelation in Reversible Colloidal Systems: W. B. Hardy.—A Preliminary Investigation of the Conditions which determine the Stability of Irreversible Hydrosols: W. B. Hardy.—On the Effects of Strain on the Thermo-electric Qualities of Metals, Part II.: Dr. M. Maclean.—On the Periodicity in the Electric *Touch* of Chemical Elements: Prof. J. C. Bose.

ROYAL INSTITUTION, at 3.—The Senses of Primitive Man: Dr. W. H. R. Rivers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Adjourned Discussion on the Report of the Institution's Visit to Switzerland.—*And if time permit*: An Electrolytic Centrifugal Process for the Production of Copper Tubes: Sherard Cowper-Coles.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 9.—Motive Power, High Speed Navigation, Steam Turbines: Hon. C. A. Parsons, F.R.S.

PHYSICAL SOCIETY, at 5.—Some Developments in the Use of Price's Guard Wire in Insulation Tests: Prof. Ayrton and Mr. Mather.—Reflection and Transmission of Electric Waves along Wires: Dr. E. Barton and Mr. L. Lownds.—The Frequency of the Transverse Vibrations of a Stretched India-rubber Cord: T. J. Barker.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Water Meters of the Present Day, with special reference to Small Flows and Waste in Dribbles: William Schönheyder.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Simplon Tunnel: C. B. Fox.

SATURDAY, JANUARY 27.

MATHEMATICAL ASSOCIATION (University College, Gower Street, W.C.), at 2.—Dynamical Applications of the Theory of Correspondence: Sir Robert S. Ball.—Triangles Triply in Perspective: J. A. Third.—The Teaching of Indices and Surds: Prof. R. W. Genese.—Illustrations of Porismatic Equations: T. J. Bromwich.—A Note on the Focoids: R. F. Davis.

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